

2<sup>ND</sup> QUARTER 2006  
GROUNDWATER DATA REPORT

PCB MOBILITY AND  
MIGRATION INVESTIGATION

SOLUTIA INC.  
W.G. KRUMMRICH FACILITY  
SAUGET, ILLINOIS

*Prepared for*  
Solutia Inc.  
575 Maryville Centre Dr  
St. Louis, Missouri 63141

October 2006

**URS**

URS Corporation  
1001 Highland Plaza Drive West, Suite 300  
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Project # 21561640

**SOLUTIA - 263**



SOLUTIA

*Solutions for a better life.*

**Solutia Inc.**

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October 20, 2006

Mr. Kenneth Bardo  
U.S EPA Region V  
Corrective Action Section  
Enforcement Compliance Branch  
77 West Jackson Boulevard DE-J9  
Chicago, IL 60604-3507

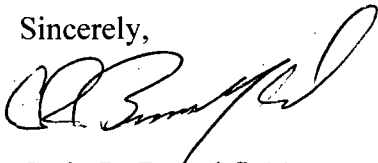
Re: PCB Mobility and Migration Phase Investigation  
2<sup>nd</sup> Quarter 2006 Groundwater Data Report  
W.G Krummrich Plant

Dear Mr. Bardo,

Enclosed please find the PCB Mobility and Migration Phase Investigation 2<sup>nd</sup> Quarter 2006 Groundwater Data Report for the W.G. Krummrich Facility.

If you have any questions or comment regarding the enclosed report please call me at (314) 674-6768.

Sincerely,



Craig R. Branchfield  
Manager, Remedial Projects

**2<sup>ND</sup> QUARTER 2006  
GROUNDWATER DATA REPORT**

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## 1.0 INTRODUCTION

Solutia Inc. (Solutia) is conducting groundwater monitoring activities as outlined in the PCB Mobility and Migration Study Work Plan (Solutia, 2005). This report presents the results of the 2<sup>nd</sup> quarter sampling event as part of the Phase III Site Investigation. Solutia intends to submit data reports, such as this one, for the quarterly events that make up the two-year baseline monitoring period (2Q06 to 1Q08). The site location map is presented on **Figure 1**.

Through the 2<sup>nd</sup> quarter 2006, three new well clusters have been installed consisting of seven new monitoring wells. One of the wells (PMA-MW-4S) was nested with PSMW-2 to complete a well nest located within the Former PCB Manufacturing Area (PMA). The other six wells (PMA-1S, -1M, 2S, -2M, -3S, and -3M) complete three additional nested clusters located downgradient of the 25 mg/kg Total polychlorinated biphenyls (PCB) isoconcentration line. Each well cluster consists of a five ft long screen in the shallow hydrogeologic unit (SHU) (from approximately el 395 to 380 ft NAVD) and in the middle hydrogeologic unit (MHU) (from approximately el 380 to 350 ft NAVD).

Groundwater samples were obtained from a total of eight monitoring wells during the 2<sup>nd</sup> quarter. The sample from PSMW-2 was collected during the Plume Stability Monitoring Program and the results are also included in this report. Laboratory data sheets and relevant field sampling information are included in the 2<sup>nd</sup> Quarter Plume Stability Groundwater Data Report.

The monitoring well locations are shown on **Figure 2**. The field sampling activities were conducted in accordance with the procedures outlined in the PCB Mobility and Migration Investigation Work Plan including the collection of appropriate quality assurance and quality control (QA/QC) samples.

## 2.0 FIELD PROCEDURES

URS Corporation (URS) conducted the 2<sup>nd</sup> quarter field activities on June 23<sup>rd</sup>, 29<sup>th</sup> and 30<sup>th</sup>, 2006. The following section summarizes the field investigative procedures.

Static groundwater levels and total well depths were measured and the presence of non-aqueous phase liquids was evaluated using an oil/water interface probe at the well locations. Well gauging information for the 2<sup>nd</sup> quarter event is presented in **Table 1**. Monitoring well PMA-MW-4S had a measured DNAPL thickness of 0.72 ft. Groundwater potentiometric surface maps of the SHU and MHU are presented on **Figures 3 and 4**, respectively.

Low-flow sampling techniques were used for groundwater sample collection. At each monitoring well location, a submersible pump attached to polyethylene tubing was slowly lowered down the well and secured. The pump intake was set near the middle or slightly above the middle of the screened interval. The other end of the polyethylene tubing was connected to a flow-through cell which discharged into a 5-gallon plastic bucket. The pump flow rates were started at approximately 100ml/min and increased to a maximum of 500 ml/min during purging. Water level measurements were initially recorded approximately every two minutes to assess whether significant drawdown was occurring. If significant drawdown occurred, the flow rates were scaled back. Drawdown was monitored to ensure that it did not exceed

25% of the distance between the pump intake and the top of the screen (approximately 0.62 ft). Once the flow rate and drawdown were stable, field measurements were collected approximately every three to five minutes. Field measurements are presented on the groundwater purging and sampling forms, in **Appendix A**. Groundwater was considered stable when the following criteria had been met over a minimum of three successive flow-through cell volumes:

- pH  $\pm 0.2$  units
- Specific Conductance  $\pm 3\%$
- Dissolved Oxygen (DO)  $\pm 10\%$  or  $\pm 0.2$  mg/L whichever is greater
- Oxidation-Reduction Potential (ORP)  $\pm 20$  mV

Once stabilization was achieved, samples were collected in the following order:

- Volatile Organic Compounds (VOCs)
- Semivolatile Organic Compounds (SVOCs)
- Polychlorinated biphenyls (PCBs), filtered and unfiltered (field filtered using a 0.45 micron filter)

QA/QC samples consisting of analytical duplicates (AD) and equipment blanks (EB) were collected at a rate of 10% and matrix spike/matrix spike duplicates (MS/MSD) were collected at a rate of 5%, complying with the work plan. In addition, trip blanks accompanied each shipment containing samples for VOC analysis. All samples were submitted to Severn-Trent Laboratory (STL) facility in Savannah, Georgia, for analysis.

The sample identification system for groundwater samples included the following nomenclature "PMA2S-0306" which denotes PCB Manufacturing Area monitoring well number 2S sampled in March 2006. QA/QC samples are identified by the suffix AD, EB or MS/MSD.

Field personnel recorded the project identification and number, sample description/location, required analysis, date and time of sample collection, type and matrix of sample, number of sample containers, analysis requested/comments, and sampler signature/date/time, with permanent ink on the chain-of-custody (COC). COC forms are included in **Appendix B**.

Samples were placed on ice inside a cooler immediately following sampling. Courier service was provided by STL's facility in Earth City, Missouri. Sample containers were packed in such a way as to help prevent breakage. Samples were shipped in coolers, each containing ice to maintain inside temperature at approximately 4°C. Sample coolers were sealed between the lid and sides of the cooler with a custody seal prior to shipment. The samples were shipped to the STL facility in Savannah, Georgia by means of an overnight delivery service.

### 3.0 LABORATORY PROCEDURES

Samples were analyzed by STL for the 40 CFR 264 Appendix IX VOCs, SVOCs, PCBs, using the following methodologies:

- VOCs, via Method 8260B
- SVOCs, via Method 8270C
- PCBs, via Method 680

#### 4.0 QUALITY ASSURANCE

Analytical data were reviewed for quality and completeness as described in the Plume Mobility Monitoring Plan. Data qualifiers were added, as appropriate, and are included on the data tables and the laboratory result pages. The Quality Assurance report is included as **Appendix C**. Laboratory result pages are included in **Appendix D**.

A total of 11 samples (seven investigative groundwater samples, one field duplicate and one MS/MSD and one equipment blank) were prepared and analyzed by STL for VOCs, SVOCs and PCBs. The results for the various analyses were submitted as sample delivery groups (SDGs) KPM001 and KPM002. The results for well PS-MW-2 are included in the 2<sup>nd</sup> Quarter Groundwater Data Report for the Plume Stability Monitoring Program.

Evaluation of the analytical data followed procedures outlined in the USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review, 1999 and USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review, 2004 and the Plume Stability Monitoring Plan, 2005. Based on the above mentioned criteria, it is recommended that the results reported for the analyses performed be accepted for their intended use with the exception of rejected (R) data. Acceptable levels of accuracy and precision, based on MS/MSD, LCS, surrogate and field duplicate data were achieved for these SDGs to meet the project objectives. Completeness which is defined to be the percentage of analytical results which are judged to be valid, including estimated (J/UJ) data was 97 percent.

#### 5.0 OBSERVATIONS

This section presents a brief summary of the groundwater analytical results from the 2<sup>nd</sup> quarter sampling event. **Table 2** presents the analytical detections for the 2<sup>nd</sup> quarter samples. **Figure 5** displays PCB (unfiltered), PCB (filtered), and total chlorobenzenes results from the 2<sup>nd</sup> Quarter sampling event. The following observations are presented based on a review of these results:

- VOCs were detected in 7 of the 8 wells. Benzene and chlorobenzenes (e.g., monochlorobenzene, 1,2-dichlorobenzene (DCB), 1,3-DCB, and 1,4-DCB) were detected most frequently and at the highest concentrations. No VOCs were detected in well PMA-MW-1S.
- SVOCs were detected in 5 of the 8 monitoring wells. The most frequently detected SVOCs were p-chloroaniline and phenol. SVOCs were not detected in wells PMA-MW-1S, -2S, and -3S.
- PCBs were detected in unfiltered samples from 5 of the 8 monitoring wells. PCBs were not detected in unfiltered samples from wells PMA-MW-1S, -1M, and -2S. No PCBs were detected in the filtered samples.

- The highest concentration of PCBs was detected in the unfiltered sample from well PMA-MW-4S (258.14 ug/L), which is located in the Former PCB Manufacturing Area. PCBs were not detected in the filtered sample from this well. The presence of DNAPL in this well likely contributed to the observed concentrations. Wells exhibiting DNAPL will not be sampled in future events as agreed with USEPA.
- The data show that lateral migration of PCBs in the SHU is relatively limited. Total PCB results from two of the three downgradient wells in the SHU were non detect for both unfiltered and filtered samples. Total PCBs were detected in the unfiltered sample from the southern downgradient well (PMA-MW-3S) at a concentration of 0.66 ug/L, but were not detected in the filtered sample.
- PCBs were detected in unfiltered samples from the MHU in two of the three downgradient wells (PMA-MW-2M and PMA-MW-3M), at concentrations of 2.3 ug/L and 5.18 ug/L, respectively. PCBs were not detected in filtered samples from these wells.
- The data from this event support the site model of low mass flux from the SHU and limited lateral migration in the MHU.

Solutia will continue to collect groundwater samples on a quarterly basis during the baseline monitoring period and will prepare reports similar to this.

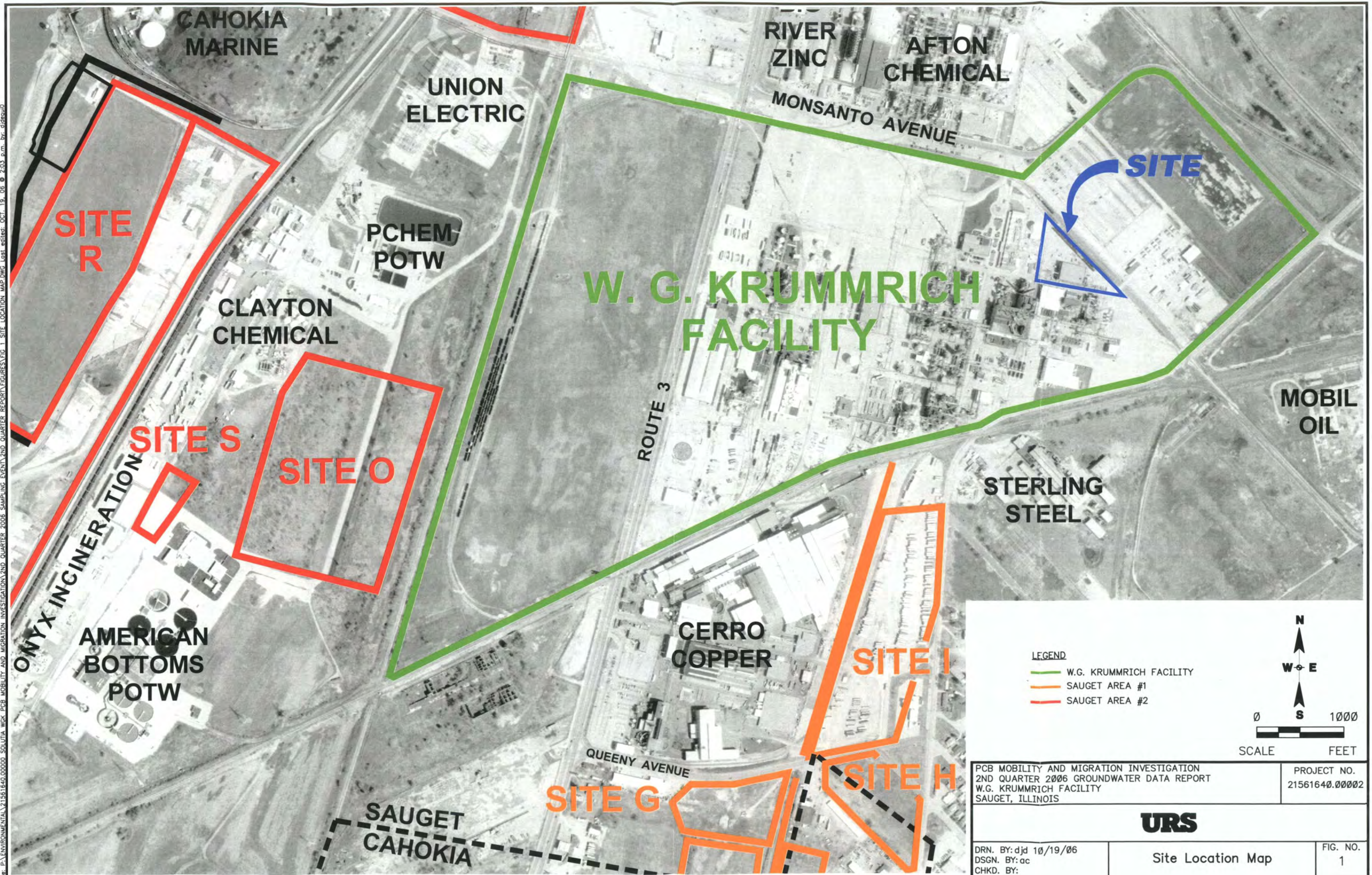
## 6.0 REFERENCES

- U.S. Environmental Protection Agency (USEPA), 1999. Contract Laboratory Program National Functional Guidelines for Organic Data Review.
- U.S. Environmental Protection Agency (USEPA), 2004. Contract Laboratory Program National Functional Guidelines for Inorganic Data Review.
- Solutia Inc., 2005. PCB Mobility and Migration Investigation Plan, W.G. Krummrich Facility, Sauget, IL, Prepared by URS Corporation, October 2005.

## Figures

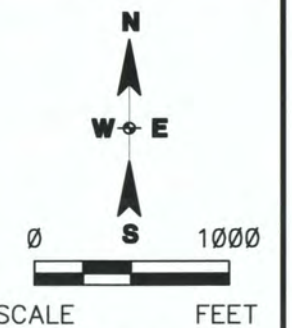


File: P:\ENVIRONMENTAL\21561640.00000 SOLUTIA W.G. PCB MOBILITY AND MIGRATION INVESTIGATION\2ND QUARTER REPORT\FIGURE\FIG 1 SITE LOCATION MAP.DWG Last edited: OCT. 19, 06 @ 2:03 p.m. by: didequ0



LEGEND

- W.G. KRUMMRICH FACILITY
- SAUGET AREA #1
- SAUGET AREA #2



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2ND QUARTER 2006 GROUNDWATER DATA REPORT  
W.G. KRUMMRICH FACILITY  
SAUGET, ILLINOIS

PROJECT NO.  
21561640.00002

URS

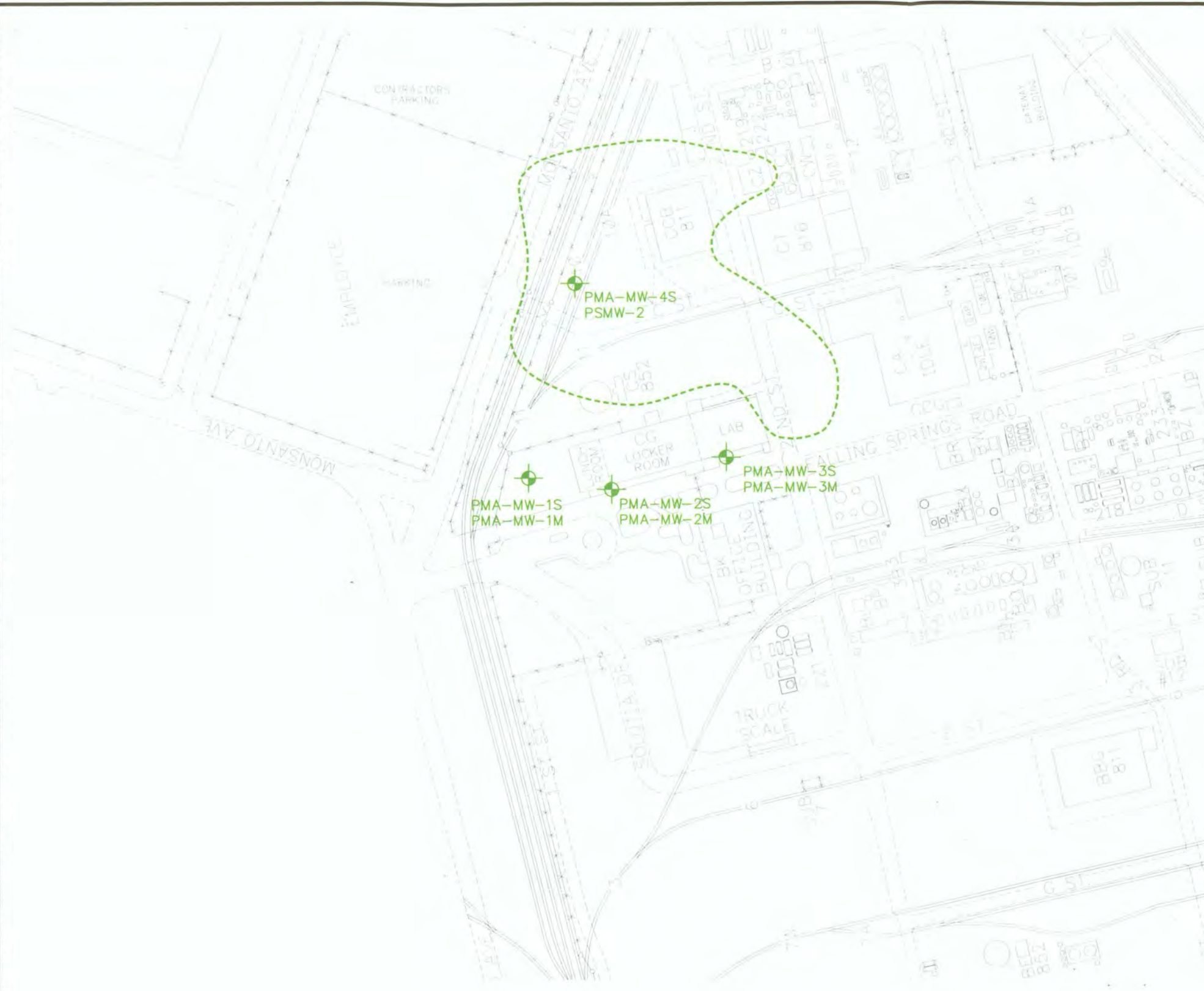
DRN. BY: djd 10/19/06  
DSGN. BY: ac  
CHKD. BY:

Site Location Map



FIG. NO.  
1

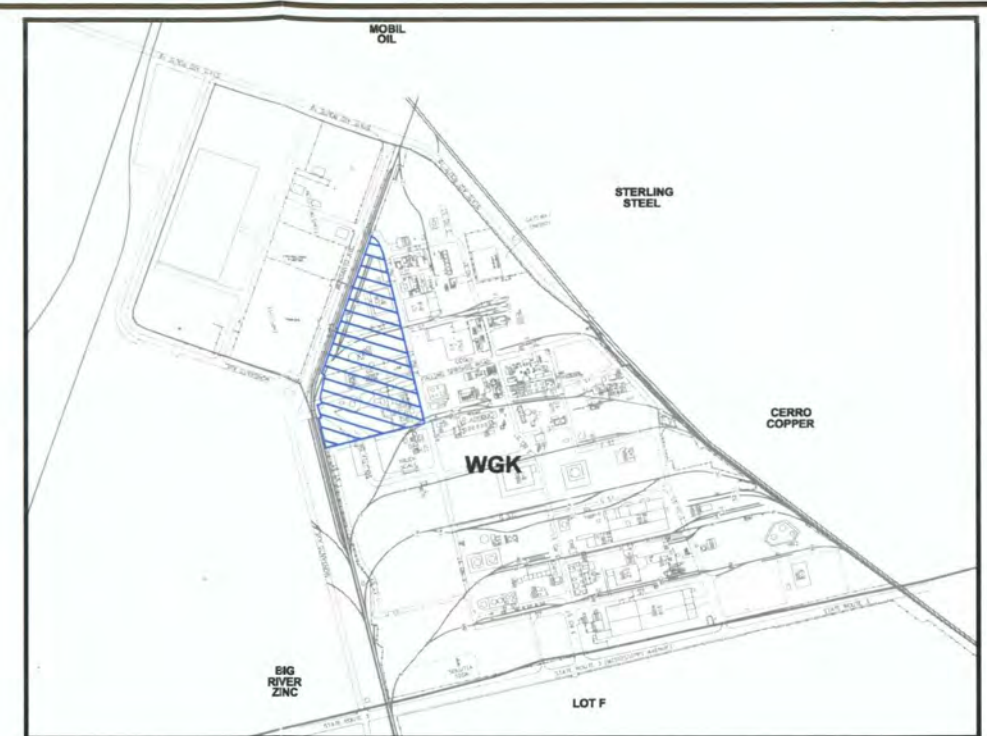


File: P:\ENVIRONMENTAL\21561640.00000 SOLUTIA WGK PCB MOBILITY AND MIGRATION INVESTIGATION\2ND QUARTER 2006 SAMPLING EVENT\2ND QUARTER REPORT\FIGURES\FIG-2 PCB MOBILITY AND MIGRATION WELL LOCATIONS.DWG Last edited: OCT. 19. 05 @ 2:12 p.m. by: djdsguid



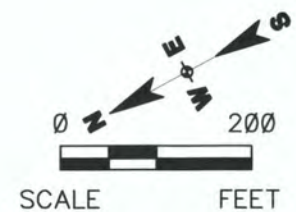
**LEGEND**

-  MONITORING WELL LOCATION
-  APPROXIMATE 25 mg/kg TOTAL PCB CONTOUR LINE (SOIL)



**KEYMAP**

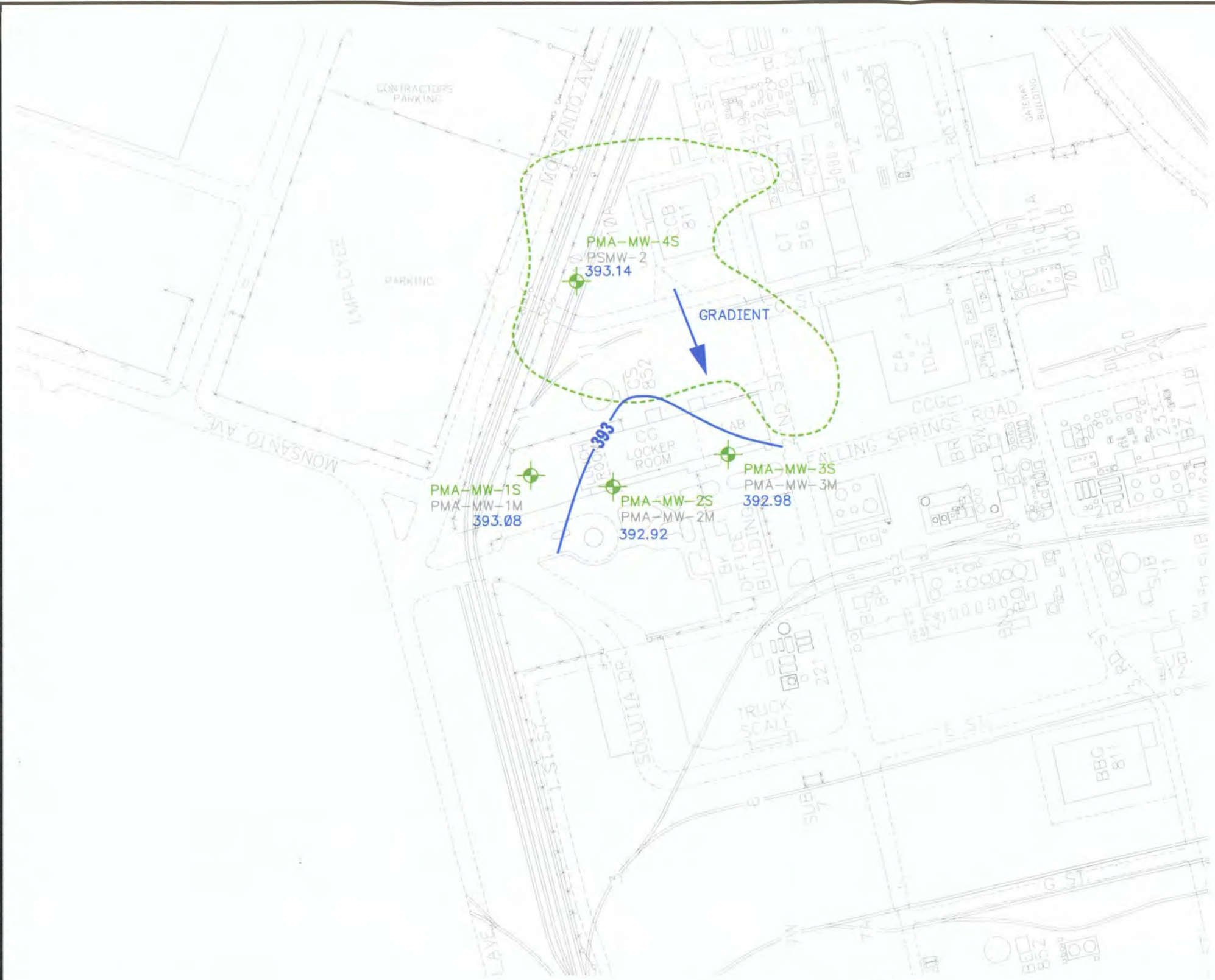
1" = 1000'



PCB MOBILITY AND MIGRATION INVESTIGATION 2ND QUARTER 2006 GROUNDWATER DATA REPORT W.G. KRUMMRICH FACILITY SAUGET, ILLINOIS		PROJECT NO. 21561640.00002
<b>URS</b>		
DRN. BY: djd 10/19/06 DSGN. BY: tja CHKD. BY: bb	Former PCB Manufacturing Monitoring Well Locations	FIG. NO. 2



File: P:\ENVIRONMENTAL\21561640\00000 SOLUTIA W.G. PCB MOBILITY AND MIGRATION INVESTIGATION\2ND QUARTER 2006 SAMPLING EVENT\2ND QUARTER REPORT\FIGURES\FIG-3 (SHALLOW) DWG Lost edited: OCT. 19, 06 @ 2:23 p.m. by: dldquo



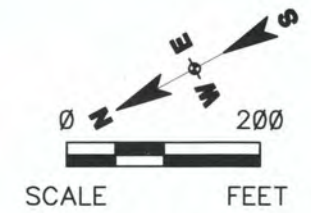
LEGEND

- MONITORING WELL LOCATION
- 393** — GROUNDWATER ELEVATION CONTOUR (FT NAVD)
- — — APPROXIMATE 25 mg/kg TOTAL PCB CONTOUR LINE (SOIL)

NOTE:  
GROUNDWATER LEVEL MEASUREMENTS WERE RECORDED  
ON JUNE 23, 2006.



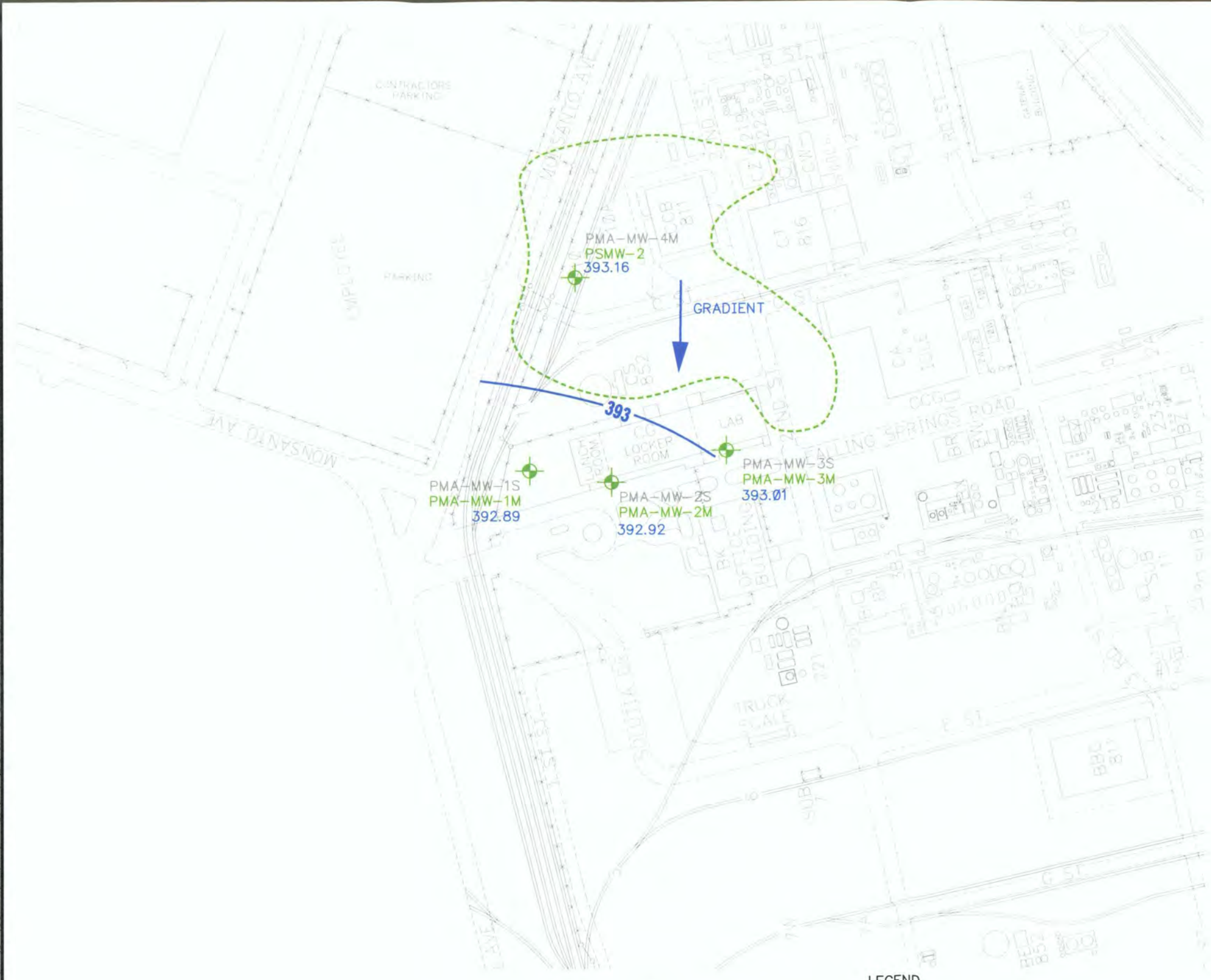
KEYMAP  
1" = 1000'



PCB MOBILITY AND MIGRATION INVESTIGATION 2ND QUARTER 2006 GROUNDWATER DATA REPORT W.G. KRUMMRICH FACILITY SAUGET, ILLINOIS		PROJECT NO. 21561640.000002
<b>URS</b>		
DRN. BY: djd 10/19/06 DSGN. BY: tja CHKD. BY: bb	Potentiometric Surface Map Shallow Hydrogeologic Unit	FIG. NO. 3

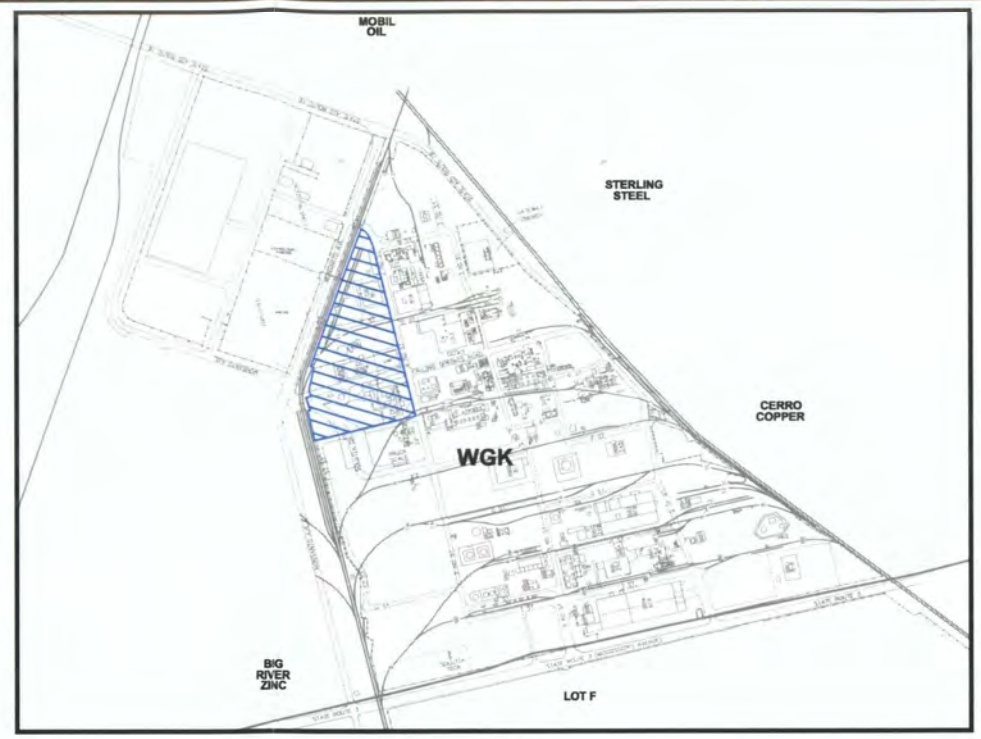


File: P:\ENVIRONMENTAL\21561640.00000 SOLUTIA WGK PCB MOBILITY AND MIGRATION INVESTIGATION\2ND QUARTER REPORT\FIGURES\FIG-4 MIDDLE.DWG last edited: OCT. 19, 06 @ 2:11 p.m. by: ddsqud0

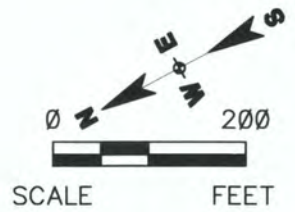


- LEGEND**
- MONITORING WELL LOCATION
  - 393** GROUNDWATER ELEVATION CONTOUR (FT NAVD)
  - APPROXIMATE 25 mg/kg TOTAL PCB CONTOUR LINE (SOIL)

NOTE:  
GROUNDWATER LEVEL MEASUREMENTS WERE RECORDED  
ON JUNE 23, 2006.



**KEYMAP**  
1" = 1000'



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URS			
DRN. BY: djd 10/19/06 DSGN. BY: tja CHKD. BY: bb	Potentiometric Surface Map Middle Hydrogeologic Unit		FIG. NO. 4





Well Information	Chemical	Result
PMAMW-1S	PCBs (unfiltered)	ND
	PCBs (filtered)	ND
	Total Chlorobenzenes	ND

Well Information	Chemical	Result
PMAMW-2S	PCBs (unfiltered)	ND
	PCBs (filtered)	ND
	Total Chlorobenzenes	ND

Well Information	Chemical	Result
PMAMW-4S	PCBs (unfiltered)	258.14
	PCBs (filtered)	ND
	Total Chlorobenzenes	11,090

Well Information	Chemical	Result
PMAMW-3S	PCBs (unfiltered)	0.66
	PCBs (filtered)	ND
	Total Chlorobenzenes	9.4

LEGEND

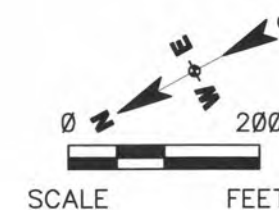
-  MONITORING WELL LOCATION
-  APPROXIMATE 25 mg/kg TOTAL PCB CONTOUR LINE (SOIL)



KEYMAP  
1" = 1000'

NOTES:

- 1) TOTAL CHLOROBENZENES RESULTS INCLUDE THE SUM OF MONOCHLOROBENZENE, 1,2-DICHLOROBENZENE, 1,3-DICHLOROBENZENE, 1,4-DICHLOROBENZENE, AND 1,2,4-TRICHLOROBENZENE.
- 2) TOTAL PCBs RESULTS INCLUDE THE SUM OF ALL METHOD 680 HOMOLOGS.
- 3) ND DENOTES NOT DETECTED.
- 4) RESULTS SHOWN ARE IN ug/l.
- 5) MULTIPLE SAMPLE RESULTS INDICATE A DUPLICATE SAMPLE.



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2ND QUARTER 2006 GROUNDWATER DATA REPORT  
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SAUGET, ILLINOIS

PROJECT NO.  
21561640.00002

**URS**

DRN. BY: djd 10/19/06  
DSGN. BY: tja  
CHKD. BY: bb

PCB and Chlorobenzene Results  
SHU Wells

FIG. NO.  
5



File: P:\ENVIRONMENTAL\21561640.00000 SOLUTIA W.G. PCB MOBILITY AND MIGRATION INVESTIGATION\2ND QUARTER 2006 SAMPLING EVENT\2ND QUARTER REPORT\FIGURES\FIG-6 TOTAL PCB AND CHLOROBENZENE.DWG Last edited: OCT 19, 06 @ 2:37 p.m. by: gideau0



Well Information	Chemical	Result
PSMW-2	PCBs (unfiltered)	0.34
	PCBs (filtered)	ND
	Total Chlorobenzenes	520

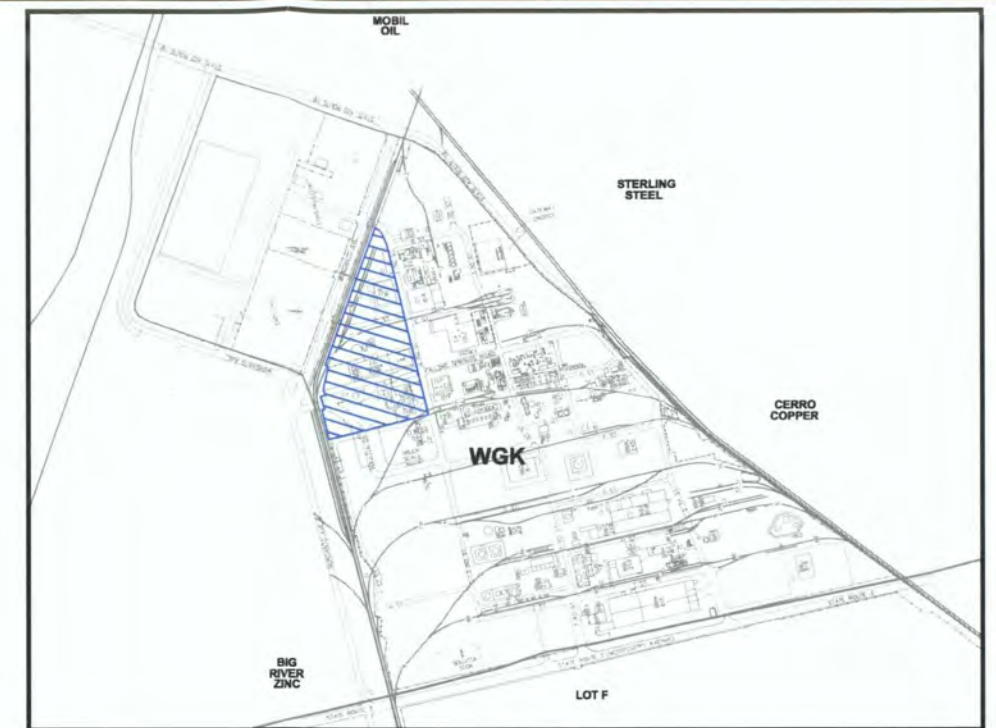
Well Information	Chemical	Result
PMAMW-1M	PCBs (unfiltered)	ND
	PCBs (filtered)	ND
	Total Chlorobenzenes	1,600

Well Information	Chemical	Result
PMAMW-2M	PCBs (unfiltered)	2.1 / 2.3
	PCBs (filtered)	ND / ND
	Total Chlorobenzenes	11,000 / 11,000

Well Information	Chemical	Result
PMAMW-3M	PCBs (unfiltered)	5.18
	PCBs (filtered)	ND
	Total Chlorobenzenes	2,097

#### LEGEND

-  MONITORING WELL LOCATION
-  APPROXIMATE 25 mg/kg TOTAL PCB CONTOUR LINE (SOIL)

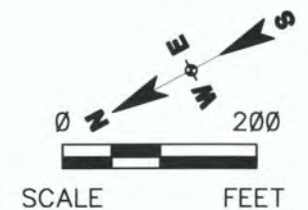


#### KEYMAP

1" = 1000'

#### NOTES:

- 1) TOTAL CHLOROBENZENES RESULTS INCLUDE THE SUM OF MONOCHLOROBENZENE, 1,2-DICHLOROBENZENE, 1,3-DICHLOROBENZENE, 1,4-DICHLOROBENZENE, AND 1,2,4-TRICHLOROBENZENE.
- 2) TOTAL PCBs RESULTS INCLUDE THE SUM OF ALL METHOD 680 HOMOLOGS.
- 3) ND DENOTES NOT DETECTED.
- 4) RESULTS SHOWN ARE IN ug/l.
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DRN. BY: djd 10/19/06  
DSGN. BY: tja  
CHKD. BY: bb

PCB and Chlorobenzene Results  
MHU Wells

FIG. NO.  
6

## Tables



Table 1  
Monitoring Well Gauging Information

Well ID	Ground Elevation (ft)* NAVD 88	TOC Elevation (ft)* NAVD 88	Top of Screen Interval (ft)**	Bottom of Screen Interval (ft)**	Top of Screen Interval (Elevation) *	Bottom of Screen Interval (Elevation) *	Depth to Bottom (ft)***	June 20-22, 2006		
								Depth to Water (ft) ***	Depth to Product (ft) ***	Water Elevation (ft)*
Shallow Hydrogeologic Unit (SHU 395 - 380 ft NAVD)										
PMAMW-1S	410.30	410.06	19.9	24.9	390.4	385.4	24.90	16.98		393.08
PMAMW-2S	412.27	411.66	22.33	27.33	389.94	384.94	27.33	18.74		392.92
PMAMW-3S	412.37	412.06	22.4	27.4	389.97	384.97	27.4	19.08		392.98
PMAMW-4S	411.09	410.43	20.33	25.33	390.76	385.76	25.33	17.29	24.6	393.14
Middle Hydrogeologic Unit (MHU 380 - 350 ft NAVD)										
PMAMW-1M	410.32	410.08	54.3	59.3	356.02	351.02	59.3	17.19		392.89
PMAMW-2M	412.26	411.93	56.54	61.54	355.72	350.72	61.54	19.01		392.92
PMAMW-3M	412.36	412.10	56.81	61.81	355.55	350.55	61.81	19.09		393.01
PSMW-2	411.22	410.88	68.55	73.55	342.67	337.67	73.55	17.72		393.16

Notes:

TOC denotes top of casing

\* Elevation based upon NAVD 88 datum

\*\* Feet below ground surface

\*\*\* Depth is measured from TOC

Coordinates--State Plane 1983, Illinois West, NAD 1983

**Table 2**  
**Groundwater Analytical Detections**

Sample ID	Sample Date	Chemical Group	Chemical	Result	Units	Lab Qualifiers	URS Qualifiers
PMA1M-0606	6/29/06	VOCs	Benzene	2,500	ug/L		
PMA1M-0606	6/29/06	VOCs	Chlorobenzene	1,600	ug/L		
PMA1M-0606	6/29/06	SVOCs	P-Chloroaniline	70	ug/L		J
PMA1M-0606	6/29/06	SVOCs	Phenol	39	ug/L		J
PMA2S-0606	6/30/06	VOCs	Chloroform	3.40	ug/L		
PMA-2M-0606	6/29/06	VOCs	Benzene	4,400	ug/L		
PMA-2M-0606	6/29/06	VOCs	Chlorobenzene	11,000	ug/L		
PMA-2M-0606	6/29/06	SVOCs	P-Chloroaniline	150	ug/L		
PMA-2M-0606	6/29/06	PCBs	Monochlorobiphenyl	2.10	ug/L		
PMA-2M-0606-AD	6/29/06	VOCs	Benzene	4,300	ug/L		
PMA-2M-0606-AD	6/29/06	VOCs	Chlorobenzene	11,000	ug/L		
PMA-2M-0606-AD	6/29/06	SVOCs	P-Chloroaniline	160	ug/L	D	
PMA-2M-0606-AD	6/29/06	SVOCs	Phenol	11	ug/L		
PMA-2M-0606-AD	6/29/06	PCBs	Monochlorobiphenyl	2.30	ug/L		
PMA3S-0606	6/29/06	VOCs	1,3-Dichlorobenzene	1.60	ug/L		
PMA3S-0606	6/29/06	VOCs	Chlorobenzene	7.80	ug/L		
PMA3S-0606	6/29/06	PCBs	Dichlorobiphenyl	0.12	ug/L		
PMA3S-0606	6/29/06	PCBs	Monochlorobiphenyl	0.54	ug/L		
PMA3M-0606	6/29/06	VOCs	1,2-Dichlorobenzene	150	ug/L		
PMA3M-0606	6/29/06	VOCs	1,3-Dichlorobenzene	47	ug/L		
PMA3M-0606	6/29/06	VOCs	1,4-Dichlorobenzene	600	ug/L		
PMA3M-0606	6/29/06	VOCs	Benzene	1,600	ug/L		
PMA3M-0606	6/29/06	VOCs	Chlorobenzene	1,300	ug/L		
PMA3M-0606	6/29/06	VOCs	Ethylbenzene	110	ug/L		
PMA3M-0606	6/29/06	VOCs	Toluene	24	ug/L		
PMA3M-0606	6/29/06	VOCs	Xylenes, Total	350	ug/L		
PMA3M-0606	6/29/06	SVOCs	2,4-Dimethylphenol	40	ug/L		
PMA3M-0606	6/29/06	SVOCs	3 & 4 Methylphenol	16	ug/L		
PMA3M-0606	6/29/06	SVOCs	Naphthalene	29	ug/L		
PMA3M-0606	6/29/06	SVOCs	P-Chloroaniline	120	ug/L		
PMA3M-0606	6/29/06	PCBs	Dichlorobiphenyl	0.68	ug/L		
PMA3M-0606	6/29/06	PCBs	Monochlorobiphenyl	4.50	ug/L	D	
PMA4S-0606	6/30/06	VOCs	1,2-Dichlorobenzene	390	ug/L	D	
PMA4S-0606	6/30/06	VOCs	1,3-Dichlorobenzene	680	ug/L	D	
PMA4S-0606	6/30/06	VOCs	1,4-Dichlorobenzene	3,400	ug/L	D	
PMA4S-0606	6/30/06	VOCs	Benzene	16	ug/L		
PMA4S-0606	6/30/06	VOCs	Chlorobenzene	420	ug/L	D	
PMA4S-0606	6/30/06	VOCs	Ethylbenzene	14	ug/L		
PMA4S-0606	6/30/06	SVOCs	1,2,4-Trichlorobenzene	6,200	ug/L	D	
PMA4S-0606	6/30/06	SVOCs	2-Nitroaniline	120	ug/L		
PMA4S-0606	6/30/06	SVOCs	2-Nitrochlorobenzene	15	ug/L		
PMA4S-0606	6/30/06	SVOCs	4-Nitrochlorobenzene	15	ug/L		
PMA4S-0606	6/30/06	SVOCs	4-Nitrophenol	67	ug/L		
PMA4S-0606	6/30/06	SVOCs	Nitrobenzene	16	ug/L		
PMA4S-0606	6/30/06	SVOCs	P-Chloroaniline	59	ug/L		
PMA4S-0606	6/30/06	SVOCs	Pentachlorobenzene	32	ug/L		
PMA4S-0606	6/30/06	PCBs	Decachlorobiphenyl	0.64	ug/L		
PMA4S-0606	6/30/06	PCBs	Dichlorobiphenyl	10	ug/L	D	
PMA4S-0606	6/30/06	PCBs	Heptachlorobiphenyl	45	ug/L		
PMA4S-0606	6/30/06	PCBs	Hexachlorobiphenyl	53	ug/L	D	
PMA4S-0606	6/30/06	PCBs	Monochlorobiphenyl	1.90	ug/L		
PMA4S-0606	6/30/06	PCBs	Nonachlorobiphenyl	1.60	ug/L		
PMA4S-0606	6/30/06	PCBs	Octachlorobiphenyl	11	ug/L		
PMA4S-0606	6/30/06	PCBs	Pentachlorobiphenyl	50	ug/L		
PMA4S-0606	6/30/06	PCBs	Tetrachlorobiphenyl	58	ug/L	D	
PMA4S-0606	6/30/06	PCBs	Trichlorobiphenyl	27	ug/L	D	

See last page of table for notes.

**Table 2**  
**Groundwater Analytical Detections**

Sample ID	Sample Date	Chemical Group	Chemical	Result	Units	Lab Qualifiers	URS Qualifiers
PS2-0606	6/30/06	VOCs	Benzene	3,700	ug/L		
PS2-0606	6/30/06	VOCs	Chlorobenzene	520	ug/L		
PS2-0606	6/30/06	VOCs	Toluene	52	ug/L		
PS2-0606	6/30/06	VOCs	Xylenes, Total	110	ug/L		
PS2-0606	6/30/06	SVOCs	P-Chloroaniline	48	ug/L		
PS2-0606	6/30/06	SVOCs	Phenol	70	ug/L		
PS2-0606	6/30/06	PCBs	Dichlorobiphenyl	0.17	ug/L		
PS2-0606	6/30/06	PCBs	Monochlorobiphenyl	0.17	ug/L		
PS2-0606	6/30/06	Metals	Barium	0.68	mg/L		

Notes:

1. There were no detections associated with sample PMA1S-0606.

D = Diluted sample

J = Estimated value

mg/L = milligrams per liter

ug/L = micrograms per liter



**Appendix A**  
**Groundwater Purging and Sampling Forms**

# LOW FLOW GROUNDWATER SAMPLING DATA SHEET

PROJECT NAME: Migration Study PROJECT NUMBER: 21561640.00001 FIELD PERSONNEL: A. Christensen B. Crafton  
DATE: 6/29/06 WEATHER: 90s Sunny  
MONITORING WELL ID: PM15-0606

## INITIAL DATA

Well Diameter: 2 in  
Total Well Depth (btoc): 24.94 ft  
Depth to Water (btoc): 17.25 ft  
Depth to LNAPL/DNAPL (btoc): \_\_\_\_\_ ft  
Depth to Top of Screen (btoc): 19.94 ft  
Screen Length: 5 ft

Water Column Height (do not include LNAPL or DNAPL): 7.69 ft btoc  
If Depth to Top of Screen is > Depth to Water AND Screen Length is < 4 feet,  
Place Pump at: Total Well Depth - 0.5 (Screen Length + DNAPL Column Height) = ~22 25 ft btoc  
If Depth to Top of Screen is < Depth to Water AND Water Column Height and Screen Length are < 4ft,  
Place Pump at: Total Well Depth - (0.5 X Water Column Height + DNAPL Column Height) = \_\_\_\_\_ ft btoc  
If Screen Length and/or water column height is < 4 ft, Place Pump at: Total Well Depth - 2 ft = \_\_\_\_\_ ft btoc

Volume of Flow Through Cell ): 500 mL  
Minimum Purge Volume =  
(3 x Flow Through Cell Volume) 1500 mL  
Ambient PID/FID Reading: 0.0 ppm  
Wellbore PID/FID Reading: 0.0 ppm

## PURGE DATA

Pump Type: SS Monsoon

[illegible]

Start Time: 1403  
Stop Time: 1415

Elapsed Time: 12 MIN  
Average Purge Rate (mL/min): 400 mL/min

Water Quality Meter ID: YSI 556  
Date Calibrated: 6/29/06

## SAMPLING DATA

Sample Date: 6/29/06  
Sample Method: SS Monsoon

Sample Time: 1430  
Sample Flow Rate: 100 ml/min 400 ml/min

Analysis: VOCs SVOCs PCBs (Filtered & unfiltered)  
QA/QC:                     

**COMMENTS:**

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## LOW FLOW GROUNDWATER SAMPLING DATA SHEET

WGK PCB  
PROJECT NAME: Migration Study PROJECT NUMBER: 21561640.00001 FIELD PERSONNEL: A. Christensen B. Crafton  
DATE: 6/29/06 WEATHER: 80's Sunny  
MONITORING WELL ID: ~~ES~~ PMA1M-0606

## INITIAL DATA

Well Diameter: 2 in  
Total Well Depth (btoc): 59.30 ft  
Depth to Water (btoc): 17.46 ft  
Depth to LNAPL/DNAPL (btoc): — ft  
Depth to Top of Screen (btoc): 54.30 ft  
Screen Length: 5 ft

Water Column Height (do not include LNAPL or DNAPL): 41.84 ft btoe  
 If Depth to Top of Screen is > Depth to Water AND Screen Length is < 4 feet,  
 Place Pump at: Total Well Depth - 0.5 (Screen Length + DNAPL Column Height) = ~ 56.5 ft btoe  
 If Depth to Top of Screen is < Depth to Water AND Water Column Height and Screen Length are < 4ft,  
 Place Pump at: Total Well Depth - (0.5 X Water Column Height + DNAPL Column Height) = — ft btoe  
 If Screen Length and/or water column height is < 4 ft, Place Pump at: Total Well Depth - 2 ft = — ft btoe

Volume of Flow Through Cell ): 500 mL  
Minimum Purge Volume = 500 mL  
(3 x Flow Through Cell Volume) 1500 mL  
Ambient PID/FID Reading: 0.0 ppm  
Wellbore PID/FID Reading: 0.0 ppm

## PURGE DATA

**Pump Type:** SS Monsoon

0.2 NA 3% NA 10% or 0.2 20

[illegible]

Start Time: 1050  
Stop Time: 1131

Elapsed Time: 41 min Water Quality Meter ID: YSI 556  
Average Purge Rate (mL/min): 500 mL/min / 400 mL/min / 1106 / 500 mL/min Date Calibrated: 6/29/06

## SAMPLING DATA

Sample Date: 6/29/06  
Sample Method: SS Monsoon

Sample Time: 1145 A

Sample Flow Rate: 100 ml/min 300 ml/min  
VOCs Everything else

Analysis: VOCs SVOCs PCBs (Filtered & Unfiltered)  
QA/QC: MS / MSD

**COMMENTS:**

~~PMAIM~~ PMAIM-0606 (1145) PMAIM-0606-MS (1150)  
PMAIM-0606-MD (1150)

# LOW FLOW GROUNDWATER SAMPLING DATA SHEET

WGK PCB  
PROJECT NAME: Migration Study PROJECT NUMBER: 21561640.00001 FIELD PERSONNEL: A. Christensen B. Crafton  
DATE: 6/30/06 WEATHER: 70's cloudy  
MONITORING WELL ID: ~~PMA2S-0606~~ PMA2S-0606

### INITIAL DATA

Well Diameter: 2 in  
Total Well Depth (btoc): 27.33 ft  
Depth to Water (btoc): 18.98 ft  
Depth to LNAPL/DNAPL (btoc): — ft  
Depth to Top of Screen (btoc): 22.33 ft  
Screen Length: 5 ft

Water Column Height (do not include LNAPL or DNAPL): 8.33 ft btoC  
If Depth to Top of Screen is > Depth to Water AND Screen Length is < 4 feet,  
Place Pump at: Total Well Depth - 0.5 (Screen Length + DNAPL Column Height) = 24.75 ft btoC  
If Depth to Top of Screen is < Depth to Water AND Water Column Height and Screen Length are < 4ft,  
Place Pump at: Total Well Depth - (0.5 X Water Column Height + DNAPL Column Height) = — ft btoC  
If Screen Length and/or water column height is < 4 ft, Place Pump at: Total Well Depth - 2 ft = — ft btoC

Volume of Flow Through Cell ): 500 mL  
Minimum Purge Volume =  
(3 x Flow Through Cell Volume) 1500 mL  
Ambient PID/FID Reading: NA ppm  
Wellbore PID/FID Reading: NA ppm

## PURGE DATA

**Pump Type:** SS Monsoon

[illegible]

Start Time: 0805  
Stop Time: 0835

Elapsed Time: 30 min  
Average Purge Rate (mL/min): 400 mL/min

Water Quality Meter ID: YSI 556  
Date Calibrated: 6/30/06

## SAMPLING DATA

Sample Date: 6/30/06  
Sample Method: SS Monsoon

Sample Time: 0845

Sample Flow Rate: 100 ml/min 400 ml/min  
(Vols) Everything else

Analysis: VOC's SVOC's PCB's Citric Acid Unfil.  
QA/QC:

**COMMENTS:**

## LOW FLOW GROUNDWATER SAMPLING DATA SHEET

WGK PCB  
PROJECT NAME: Migration Study PROJECT NUMBER: 21561640.00001 FIELD PERSONNEL: J. Christensen B. Crafton  
DATE: 6/29/06 WEATHER: 80's Sunny  
MONITORING WELL ID: PMAZM-06020

## INITIAL DATA

Well Diameter: 2 in  
Total Well Depth (btoc): 61.54 ft  
Depth to Water (btoc): 19.23 ft  
Depth to LNAPL/DNAPL (btoc):      ft  
Depth to Top of Screen (btoc): 56.54 ft  
Screen Length: 5 ft

Water Column Height (do not include LNAPL or DNAPL): 42.31 ft btoC  
If Depth to Top of Screen is > Depth to Water AND Screen Length is < 4 feet,  
Place Pump at: Total Well Depth - 0.5 (Screen Length + DNAPL Column Height) = 159.0 ft btoC  
If Depth to Top of Screen is < Depth to Water AND Water Column Height and Screen Length are < 4ft,  
Place Pump at: Total Well Depth - (0.5 X Water Column Height + DNAPL Column Height) =      ft btoC  
If Screen Length and/or water column height is < 4 ft, Place Pump at: Total Well Depth - 2 ft =      ft btoC

Volume of Flow Through Cell ): 500 mL  
Minimum Purge Volume =  
(3 x Flow Through Cell Volume) 1500 mL  
Ambient PID/FID Reading: 0.3 ppm  
Wellbore PID/FID Reading: 0.0 ppm

## PURGE DATA

Pump Type: SS Monsoon

[illegible]

Start Time: 1603  
Stop Time: ~~1700~~ 1650  
(10:57 June 06)

Elapsed Time: 47 min  
Average Purge Rate (mL/min): 500

Water Quality Meter ID: YSI 556  
Date Calibrated: \_\_\_\_\_

## SAMPLING DATA

Sample Date: 6/29/06 Sample Time: 1700 Analysis: VOC, SVOC, PCB<sup>15</sup>, PCB<sup>15</sup> filtered  
Sample Method: SS Monsoon Sample Flow Rate: 100 ml/min for VOC<sup>15</sup> remaining QA/QC: PMA2M-0606-AD  
samples @ 500 ml/min

**COMMENTS:**

# LOW FLOW GROUNDWATER SAMPLING DATA SHEET

PROJECT NAME: WGK PCB Migration Study PROJECT NUMBER: 21561640.00001 FIELD PERSONNEL: M. Corbett  
 DATE: 6/29/06 WEATHER: Sunny, 80s N. McNicken  
 MONITORING WELL ID: RMA MW-35

## INITIAL DATA

Well Diameter: 2 in  
 Total Well Depth (btoc): 27.40 ft  
 Depth to Water (btoc): 19.30 ft  
 Depth to LNAPL/DNAPL (btoc):      ft  
 Depth to Top of Screen (btoc): 27.40 ft  
 Screen Length: 5 ft

Water Column Height (do not include LNAPL or DNAPL): 8.10 ft btoc  
 If Depth to Top of Screen is > Depth to Water AND Screen Length is < 4 feet,  
 Place Pump at: Total Well Depth - 0.5 (Screen Length + DNAPL Column Height) = ~25 ft btoc  
 If Depth to Top of Screen is < Depth to Water AND Water Column Height and Screen Length are < 4ft,  
 Place Pump at: Total Well Depth - (0.5 X Water Column Height + DNAPL Column Height) =      ft btoc  
 If Screen Length and/or water column height is < 4 ft, Place Pump at: Total Well Depth - 2 ft =      ft btoc

Volume of Flow Through Cell ): 500 mL  
 Minimum Purge Volume =  
 (3 x Flow Through Cell Volume) 1500 mL  
 Ambient PID/FID Reading: 0.0 ppm  
 Wellbore PID/FID Reading: 0.0 ppm

## PURGE DATA

Pump Type: SS Monsoon

Purge Volume (mL)	Time	Depth to Water (ft)	Color	Odor	pH	Temp (°C)	Cond. (µmhos/cm)	Turbidity (NTUs)	DO (mg/l)	ORP (mv)
0	1100	19.30	Clr	No	7.39	21.95	1.069	6.26	0.96	99.7
300	1103	19.35	"	"	7.23	22.80	1.068	"	0.82	114.0
600	1104	19.35	"	"	7.18	23.38	1.071	"	0.72	118.4
900	1106	"	"	"	7.13	23.53	1.079	4.07	0.82	121.2
1200	1108	19.36	"	"	7.13	23.68	1.090	"	0.70	129.0
1500	1110	"	"	"	7.09	22.50	1.095	2.15	0.63	135.0
1800	1112	"	"	"	7.08	22.61	1.103	"	0.70	137.6
2400	1114	"	"	"	7.06	22.35	1.101	1.14	0.68	130.0
3900	1119	"	"	"	7.05	21.58	1.107	1.21	0.59	126.7
5400	1124	19.49	"	"	6.94	21.89	1.098	0.98	0.55	134.1
6900	1129	19.40	"	"	6.99	22.15	1.103	1.04	0.63	120.8
8400	1134	"	"	"	6.99	22.11	1.102	0.92	0.61	111.8
9900	1139	"	"	"	6.93	21.87	1.100	1.14	0.53	102.9
11400	1144	19.42	"	"	6.98	21.75	1.102	1.08	0.46	91.6
12900	1149	"	"	"	6.96	21.66	1.096	1.35	0.46	81.1
14400	1154	19.38	"	"	6.95	22.22	1.094	0.89	0.46	72.0

Start Time: 1100 Elapsed Time: 54 Water Quality Meter ID: YSI 556  
 Stop Time: 1154 Average Purge Rate (mL/min): 300 mL/min Date Calibrated: 6/29/06

## SAMPLING DATA

Sample Date: 6/29/06 Sample Time: 1200 Analysis: VOC, SVOC, PCB, PCB-Filtered  
 Sample Method: SS Monsoon Sample Flow Rate: 300 mL/min QA/QC:     

## COMMENTS:

# LOW FLOW GROUNDWATER SAMPLING DATA SHEET

PROJECT NAME: WGK PCB Migration Study PROJECT NUMBER: 21561640.00001 FIELD PERSONNEL: M. Collett  
 DATE: 6/29/06 WEATHER: Sunny, 80s  
 MONITORING WELL ID: 9MA-MW-3M

## INITIAL DATA

Well Diameter: 2 in  
 Total Well Depth (btoc): 61.81 ft  
 Depth to Water (btoc): 19.30 ft  
 Depth to LNAPL/DNAPL (btoc): - ft  
 Depth to Top of Screen (btoc): 56.81 ft  
 Screen Length: 5 ft

Water Column Height (do not include LNAPL or DNAPL): 42.51 ft btoc  
 If Depth to Top of Screen is > Depth to Water AND Screen Length is < 4 feet,  
 Place Pump at: Total Well Depth - 0.5 (Screen Length + DNAPL Column Height) = - ft btoc  
 If Depth to Top of Screen is < Depth to Water AND Water Column Height and Screen Length are < 4ft,  
 Place Pump at: Total Well Depth - (0.5 X Water Column Height + DNAPL Column Height) = - ft btoc  
 If Screen Length and/or water column height is < 4 ft, Place Pump at: Total Well Depth - 2 ft = - ft btoc

Volume of Flow Through Cell: 500 mL  
 Minimum Purge Volume =  
 (3 x Flow Through Cell Volume) 1500 mL  
 Ambient PID/FID Reading: 0.0 ppm  
 Wellbore PID/FID Reading: 0.0 ppm

## PURGE DATA

Pump Type: SS Monsoon

Purge Volume (mL)	Time	Depth to Water (ft)	Color	Odor	pH	Temp (°C)	Cond. (µmhos/cm)	Turbidity (NTUs)	DO (mg/l)	ORP (mv)
0	1512	19.32	brown	none	9.12	20.94	2.308	-0.40	0.75	-176.5
1000	1516	19.32	"	"	9.23	20.85	2.342	-	0.77	-165.9
1500	1518	19.31	"	"	9.23	21.00	2.351	-	0.75	-173.6
2000	1520	19.32	"	"	9.23	21.04	2.353	-0.70	0.75	-172.9
3250	1525	19.32	"	"	9.25	21.03	2.364	-	0.71	-165.1
4500	1530	19.32	"	"	9.24	20.67	2.367	-	0.63	-177.4
5750	1535	19.32	"	"	9.25	20.33	2.375	-0.10	0.62	-176.0
7000	1540*	19.32	"	"	9.30	20.23	2.383	-	0.53	-204.0
8250	1545	19.32	"	"	9.34	20.52	2.388	-	0.52	-227.8
9500	1550	19.32	"	"	9.41	20.02	2.410	-	0.54	-225.7
10750	1555	19.32	"	"	9.44	19.52	2.417	-0.39	0.56	-217.0

Start Time: 1512 Elapsed Time: 43 min Water Quality Meter ID: YSI 556  
 Stop Time: 1555 Average Purge Rate (mL/min): 250 Date Calibrated: 6/29/06

## SAMPLING DATA

Sample Date: 6/29/06 Sample Time: 1605 Analysis: VOCs, SVOCs, PCBs, PCBS (filtered)  
 Sample Method: SS Monsoon Sample Flow Rate: 250 QA/QC: collected equipment blank

## COMMENTS:

\*flow stopped briefly

## LOW FLOW GROUNDWATER SAMPLING DATA SHEET

PROJECT NAME: Migration Study PROJECT NUMBER: 21561640.00001 FIELD PERSONNEL: JRK/BC  
DATE: 6-30-06 WEATHER: CLAY 90's  
MONITORING WELL ID: PMAMW-4S

## INITIAL DATA

Well Diameter: 2 in  
Total Well Depth (btoc): 25.32 ft  
Depth to Water (btoc): 17.37 ft  
Depth to LNAPL/DNAPL (btoc): 24.40 ft  
Depth to Top of Screen (btoc): 20 ft  
Screen Length: 5 ft

Water Column Height (do not include LNAPL or DNAPL): 2.63 ft btoC  
If Depth to Top of Screen is > Depth to Water AND Screen Length is < 4 feet,  
Place Pump at: Total Well Depth - 0.5 (Screen Length + DNAPL Column Height) = ~22' ft btoC  
If Depth to Top of Screen is < Depth to Water AND Water Column Height and Screen Length are < 4ft,  
Place Pump at: Total Well Depth - (0.5 X Water Column Height + DNAPL Column Height) = \_\_\_\_\_ ft btoC  
If Screen Length and/or water column height is < 4 ft, Place Pump at: Total Well Depth - 2 ft = \_\_\_\_\_ ft btoC

Volume of Flow Through Cell ): 500 mL  
Minimum Purge Volume =  
(3 x Flow Through Cell Volume) 1500 mL  
Ambient PID/FID Reading: 0.0 ppm  
Wellbore PID/FID Reading: 0.0 ppm

## PURGE DATA

Pump Type:	SS Monsoon	2	NA	3%	NA	10%	$\pm 20 \text{ mV}$
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[illegible]

Start Time: 11:16 Elapsed Time: 59 minutes Water Quality Meter ID: YSI 556  
Stop Time: 12:15 Average Purge Rate (mL/min): 400 mL/min Date Calibrated: 6-30-06

## SAMPLING DATA

Sample Date: 6-30-06 Sample Time: 12:00 Analysis: VOCs/SVOCs/PCBs/PCBs Filtered  
Sample Method: SS Monsoon Sample Flow Rate: 400 mL/min QA/QC: NA

COMMENTS:  
0.73 ft of DNAPL present in well: <sup>pump</sup>~~well~~ placed above DNAPL



## Appendix B

### Chains-of-Custody

## ANALYSIS REQUEST AND CHAIN OF CUSTODY RECORD

SEVERN  
TRENT

STL

STL Savannah  
5102 LaRoche Avenue  
Savannah, GA 31404Website: www.stl-inc.com  
Phone: (912) 354-7858  
Fax: (912) 352-0165

Alternate Laboratory Name/Location

Phone:  
Fax:

PROJECT REFERENCE <b>WGG PCB Mobility</b>		PROJECT NO. <b>21561640.00001</b>	PROJECT LOCATION (STATE) <b>IL</b>	MATRIX TYPE	REQUIRED ANALYSIS										PAGE <b>1</b>	OF <b>1</b>
STL (LAB) PROJECT MANAGER <b>Lydia Guilizia</b>		P.O. NUMBER	CONTRACT NO.	COMPOSITE (C) OR GRAB (G) INDICATE AQUEOUS (WATER) SOLID OR SEMISOLID AIR NONAQUEOUS LIQUID (OIL, SOLVENT, ...)	VOCs (8260s)	SVOCs (8220s)	PCBs (680)	PCBs (680)-filtered	RESERVATIVE	STANDARD REPORT DELIVERY DATE DUE	EXPEDITED REPORT DELIVERY (SURCHARGE) DATE DUE	NUMBER OF COOLERS SUBMITTED PER SHIPMENT	REMARKS			
CLIENT (SITE) PM <b>Bob Billman</b>		CLIENT PHONE <b>314-429-0100</b>	CLIENT FAX <b>314-429-0462</b>													
CLIENT NAME <b>URS Corporation</b>		CLIENT E-MAIL														
CLIENT ADDRESS <b>1001 Highlands Plaza Dr. W. Ste. 300 St. Louis, MO 63110</b>																
COMPANY CONTRACTING THIS WORK (if applicable)																
SAMPLE		SAMPLE IDENTIFICATION			NUMBER OF CONTAINERS SUBMITTED										REMARKS	
DATE	TIME															
6/29/06	1200	PMA35-0606			X	3	2	2	2							
	1430	PMA3M-0606-EB			X	3	2	2	2							
	1605	PMA3M-0606			X	3	2	2	2							
	1145	PMA1M-0606			X	3	2	2	2							
	1150	PMA1M-0606-MS			X	3	2	2	2							
	1150	PMA1M-0606-MD			X	3	2	2	2							
	1430	PMA1S-0606			X	3	2	2	2							
		TB-6			X	X										
	1700	PMA-2M-0606			X	3	2	2	2							
	1700	PMA-2M-0606-A1			X	3	2	2	2							
MEC																
RELINQUISHED BY: (SIGNATURE)		DATE	TIME	RELINQUISHED BY: (SIGNATURE)		DATE	TIME	RELINQUISHED BY: (SIGNATURE)		DATE	TIME	RELINQUISHED BY: (SIGNATURE)		DATE	TIME	
						6/29/06	1745			6/29/06	1815			6/29/06	1815	
RECEIVED BY: (SIGNATURE)		DATE	TIME	RECEIVED BY: (SIGNATURE)		DATE	TIME	RECEIVED BY: (SIGNATURE)		DATE	TIME	RECEIVED BY: (SIGNATURE)		DATE	TIME	
						6/29/06	1745			6/29/06	1815			6/29/06	1815	
RECEIVED FOR LABORATORY BY: (SIGNATURE) <b>KL</b> DATE <b>7/1/06</b> TIME <b>0900</b>																
CUSTODY INTACT YES <input type="radio"/> NO <input type="radio"/>		CUSTODY SEAL NO.		STL SAVANNAH LOG NO. <b>680-18095</b>		LABORATORY REMARKS										



## ANALYSIS REQUEST AND CHAIN OF CUSTODY RECORD

**STL Savannah**  
5102 LaRoche Avenue  
Savannah, GA 31404

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○ Alternate Laboratory Name/Location

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SEVERN  
TRENT

# STL


PROJECT REFERENCE <b>WGK PCB Mobility</b>		PROJECT NO. <b>21561640.00001</b>		PROJECT LOCATION (STATE) <b>IL</b>		MATRIX TYPE		REQUIRED ANALYSIS										PAGE <b>1</b>		OF <b>1</b>																									
STL (LAB) PROJECT MANAGER <b>Lydia Guilizia</b>		P.O. NUMBER		CONTRACT NO.		COMPOSITE (C) OR GRAB (G) INDICATE AQUEOUS (WATER) SOLID OR SEMISOLID AIR NONAQUEOUS LIQUID (OIL, SOLVENT,...)		<table border="1"><tr><td><b>Vol. (82608)</b></td><td><b>SVOCs (8270C)</b></td><td><b>PCBs (690)</b></td><td><b>PCBs (680) - filtered</b></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td><b>HCl</b></td><td><b>None</b></td><td><b>None</b></td><td><b>None</b></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr></table>										<b>Vol. (82608)</b>	<b>SVOCs (8270C)</b>	<b>PCBs (690)</b>	<b>PCBs (680) - filtered</b>									<b>HCl</b>	<b>None</b>	<b>None</b>	<b>None</b>									STANDARD REPORT DELIVERY <b>DATE DUE</b>		EXPEDITED REPORT DELIVERY (SURCHARGE) <b>DATE DUE</b>	
<b>Vol. (82608)</b>	<b>SVOCs (8270C)</b>	<b>PCBs (690)</b>	<b>PCBs (680) - filtered</b>																																										
<b>HCl</b>	<b>None</b>	<b>None</b>	<b>None</b>																																										
CLIENT (SITE) PM <b>Bob Billman</b>		CLIENT PHONE <b>314-429-0100</b>		CLIENT FAX <b>314-429-0462</b>																																									
CLIENT NAME <b>URS Corporation</b>		CLIENT E-MAIL																																											
CLIENT ADDRESS <b>1001 Highlands Plaza Dr W, Ste. 300 St. Louis, MO 63110</b>																NUMBER OF COOLERS SUBMITTED PER SHIPMENT:																													
COMPANY CONTRACTING THIS WORK (if applicable)																																													
SAMPLE		SAMPLE IDENTIFICATION				NUMBER OF CONTAINERS SUBMITTED										REMARKS																													
DATE	TIME																																												
<b>6/30/06</b>	<b>0845</b>	<b>PMA45-0606<sup>MC</sup> PMA25-0606</b>				<b>3 2 2 2</b>																																							
		<b>TB-8</b>				<b>X</b>																																							
<div>TEMP: 77°F</div> <div>MEC</div>																																													
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DATE <b>7/2/06</b>		TIME <b>0900</b>																																											



### ANALYSIS REQUEST AND CHAIN OF CUSTODY RECORD

SEVERN  
TRENT

# STL

 **STL Savannah**  
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[illegible]



## ANALYSIS REQUEST AND CHAIN OF CUSTODY RECORD

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TRENT

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 **STL Savannah**  
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Phone:  
Fax:

[illegible]

RECEIVED FOR LABORATORY USE (SIGNATURE)		DATE	TIME	CUSTODY INTACT YES <input type="radio"/> NO <input type="radio"/>	LABORATORY USE ONLY CUSTODY SEAL NO.	STL SAVANNAH LOG NO.	LABORATORY REMARKS
<i>[Signature]</i>		07/06/00	13:00			680-1819	680-18197

## Appendix C

### Quality Assurance Report

# QUALITY ASSURANCE REPORT

Solutia Inc.  
W.G. Krummrich Facility  
Sauget, Illinois

## PCB Mobility and Migration Investigation 2<sup>nd</sup> Quarter 2006 Groundwater Data Report

*Prepared for*

Solutia Inc.  
575 Maryville Centre Drive  
St. Louis, MO 63141

October 2006

**URS**

URS Corporation  
1001 Highland Plaza Drive West, Suite 300  
St. Louis, MO 63100  
(314) 429-0100  
Project # 21561640.00002

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## 1.0 INTRODUCTION

This Quality Assurance Report presents the findings of a review of analytical data for groundwater samples collected in June 2006 at the Solutia W.G. Krummrich plant as part of the 2<sup>nd</sup> Quarter 2006 PCB Mobility and Migration Investigation. The samples were collected by URS Corporation personnel and analyzed by Severn Trent Laboratories (STL) located in Savannah, Georgia using USEPA Method 680 and USEPA SW-846 methodologies. Samples were tested for volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), and polychlorinated biphenyls (PCBs).

One hundred percent of the data were subjected to a data quality review (Level III validation). The Level III validation was performed in order to confirm that the analytical data provided by Severn Trent were acceptable in quality for their intended use.

A total of 11 samples (7 investigative groundwater samples, one field duplicate, one matrix spike and matrix spike duplicate (MS/MSD) and one equipment blank) were analyzed by STL. These samples were analyzed as two Sample Delivery Groups (SDGs) KPM001 and KPM002. The samples were analyzed according to the following USEPA SW-846 Methods:

- Method 8260B for VOCs (including dichlorobenzenes due to potential volatilization losses associated with Method 8270).
- Method 8270C for SVOCs
- Method 680 for PCBs

In addition, two trip blanks were included in the coolers that contained samples for VOC analysis and were analyzed for VOCs by Method 8260B. Samples were reviewed following procedures outlined in the USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review, October 1999, USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review, October 2004 and the PCB Mobility and Migration Investigation, (October 2005).

The above guidelines provided the criteria to review the data. Additional quantitative criteria are given in the analytical methods. Qualifiers assigned by the data reviewer have been applied to the laboratory reporting forms (Form-1s). The qualifiers indicate data that did not meet acceptance criteria and corrective actions were not successful or not performed. The various qualifiers are explained in **Table 1** below.



TABLE 1

Lab Qualifier	Definition
U	Analyte was not detected at or above the reporting limit.
*	LCS, LCSD, MS, MSD, MD or surrogate exceeds the control limits
E	Result exceeded the calibration range, secondary dilution required.
D	Surrogate or matrix spike recoveries were not obtained because the extract was diluted for analysis; also compounds analyzed at a dilution will be flagged with a D
J	Result is less than the RL but greater than or equal to the MDL and the concentration is an approximate value.
N	MS, MSD: Spike recovery exceeds upper or lower control limits.
H	Sample was prepped or analyzed beyond the specified holding time.
B	Compound was found in the blank and sample
4	MS, MSD: The analyte present in the original sample is 4 times greater than the matrix spike concentration; therefore, control limits are not applicable.

URS Qualifier	Definition
U	The analyte was analyzed for but was not detected.
J	The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.
UJ	The analyte was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.
R	The sample results are rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte cannot be verified.

Based on the criteria outlined, it is recommended that the results reported for these analyses be accepted for their intended use with the exception of rejected (R) data. Acceptable levels of accuracy, precision, and representativeness (based on MS/MSD, LCS, surrogate compounds and field duplicate results) were achieved for this data set, except where noted in this report. In addition, analytical completeness, defined to be the percentage of analytical results which are judged to be valid, including estimated detect (J) or estimated non-detect (UJ) values was 97 percent, which meets the completeness goal of 95 percent.



The data review included evaluation of the following criteria:

#### Organics

- Receipt condition and sample holding times
- Laboratory method blanks, field equipment blanks and trip blank samples
- Surrogate spike recoveries
- Laboratory control sample (LCS) recoveries
- Matrix Spike/Matrix Spike Duplicate (MS/MSD) sample recoveries and Relative Percent Difference (RPD) values
- Field duplicate results
- Results reported from dilutions
- Internal standard responses

### 2.0 RECEIPT CONDITION AND SAMPLE HOLDING TIMES

Sample holding time requirements for the analyses performed are presented in the methods and/or in the data review guidelines. Review of the sample collection, extraction and analysis dates involved comparing the chain-of-custody and the laboratory data summary forms for accuracy, consistency, and holding time compliance.

Extractions and/or analyses were completed within the recommended holding time requirements for all samples.

### 3.0 TRIP BLANKS, LABORATORY METHOD BLANK AND EQUIPMENT BLANK SAMPLES

Trip blank samples are used to assess VOC cross contamination of samples during shipment to the laboratory. One trip blank was submitted with each cooler shipped containing samples for VOC analyses for a total of two trip blank samples. Analytes were not detected in the trip blanks.

Equipment blank samples are used to assess the effectiveness of equipment decontamination procedures. Benzene (5.1 µg/L), 1,4-dichlorobenzene (6.8 µg/L), 1,2-dichlorobenzene (14 µg/L) and toluene (2.1 µg/L) were detected in equipment blank PMA3M-0606-EB. Sample results for analytes benzene (2.1 µg/L), 1,4-dichlorobenzene (14 µg/L) and 1,2-dichlorobenzene (27 µg/L) in sample PMA3S-0606 were less than 5X the equipment blank results and were qualified nondetect "U".



Laboratory method blank samples evaluate the existence and magnitude of contamination problems resulting from laboratory activities. All laboratory method blank samples were analyzed at the method prescribed frequencies. No analytes were detected in any of the method blanks.

#### 4.0 SURROGATE SPIKE RECOVERIES

Surrogate compounds are used to evaluate overall laboratory performance for sample preparation efficiency on a per sample basis. All samples analyzed for VOCs, SVOCs, and PCBs were spiked with surrogate compounds during sample preparation. USEPA National Functional Guidelines for Organic Data Review state how data is qualified, if surrogate spike recoveries do not meet acceptance criteria.

Surrogate recoveries were within evaluation criteria with the exception of the samples in the table below. When surrogates were not recovered due to dilutions, no qualifiers were assigned. Surrogates that were outside evaluation criteria in MS/MSD and equipment blank samples were not qualified because they are quality control samples and not qualified.

SDG	Sample ID	Analysis	Surrogate	Rec. %	Range	Qualification
KPM001	PMA1M-0606MS	SVOCs	Phenol-d5	111	55-104	None, sample is a matrix spike sample and qualifications are not made on MS sample alone.
KPM002	PMA4S-0606DL	SVOCs	2-fluorobiphenyl	0 D	59-103	None, surrogates were not recovered due to high level of dilution in the sample.
		SVOCs	2-fluorophenol	0 D	56-100	
		SVOCs	Nitrobenzene-d5	0 D	60-102	
		SVOCs	Phenol-d5	0 D	55-104	
		SVOCs	2,4,6-Tribromophenol	0 D	55-126	
		SVOCs	Terphenyl-d14	0 D	10-154	

#### 5.0 LABORATORY CONTROL SAMPLE RECOVERIES

Laboratory control samples (LCS) are analyzed with each analytical batch to assess the accuracy of the analytical process. All LCS recoveries were within evaluation criteria with the exception of the LCSs in the table below. Qualifications were assigned as appropriate.

Data that was reported as nondetect and associated with LCS recoveries above evaluation criteria, indicating a possible high bias, did not require qualification. Also if the LCS was related to QA/QC samples such as trip blanks, and MS/MSDs, no qualifiers were assigned.

SDG	LSC ID	Sample ID	LCS compound	Rec. %	Range	Qualification
KPM002	680-49310/3-A	PMA4S-0606	Aniline	0	10-92	Rejected "R"
KPM002	680-49310/3-A	PMA4S-0606	Pyridine	0	10-178	Rejected "R"
KPM002	680-49310/3-A	PMA4S-0606	N-Nitrosodimethylamine	47	50-137	Estimated nondetect "UJ"



Analytes aniline and pyridine were rejected because they were not recovered in the LCS. The National Functional Guidelines for Organic Data Review state if LCS recoveries for an analyte are less than 10% and nondetect in the sample, then the data should be rejected.

## 6.0 MATRIX SPIKE/MATRIX SPIKE DUPLICATE (MS/MSD) SAMPLES

MS/MSD samples are analyzed to assess the accuracy and precision of the analytical process on an analytical sample in a particular matrix. MS/MSD samples were required to be collected at a frequency of one per 20 investigative samples in accordance with the work plan. URS Corporation submitted one MS/MSD sample set for 7 investigative samples meeting the work plan frequency requirement.

No qualifications were made to the data if the MS/MSD percent recoveries were zero due to dilutions or if the percent RPD was the only factor out of criteria. Also, USEPA National Functional Guidelines for Organic Data Review (October 1999) states that organic data should not be qualified based on MS/MSD criteria alone. Therefore, if recoveries were outside evaluation criteria due to matrix interference or abundance of analytes, no qualifiers were assigned unless these analytes had other quality control criteria outside evaluation criteria.

The MS/MSD recoveries and RPDs that did not meet evaluation criteria are in the table below.

SDG	Analysis	Analyte	MS/MS D %Rec.	Criteria %	RPD %	RPD Limit	Qualifier
KPM001	VOCs	Dichlorodifluoromethane	56/61	70-130	4	30	No, qualifiers were assigned since all other QC parameters met criteria.
KPM001	SVOCs	Bis(2-chloroethoxy)methane 4-chloroaniline 4-chloro-3-methylphenol 4,6-dinitro-2-methylphenol Benzyl alcohol 2-chlorophenol 2,4-dichlorophenol 2,4-dimethylphenol Isophorone 2-methylphenol	147/127 180/146 621/533 163/156 121/107 109/99 113/98 118/104 115/101 113/99	55-115 22-107 58-118 42-155 54-116 54-106 62-112 51-111 60-113 57-110	14 14 15 4 13 9 14 12 13 13	40 40 40 40 40 40 40 40 40 40	All detects "J" and all nondetects "UJ" in sample PMA1M-0606. Although all other QC parameters met criteria. The sample was qualified due to the level of uncertainty between the parent and MS/MSD results.
KPM001	PCBs	Monochlorobiphenyl	-174/- 179	18-97	8	40	All nondetects "UJ". Although all other QC parameters met criteria. The sample was qualified due to the level of uncertainty between the parent and MS/MSD results.

## 7.0 FIELD DUPLICATE RESULTS

Field duplicate results are used to evaluate precision of the entire data collection activity, including sampling, analysis and site heterogeneity. When results for both duplicate and sample values are greater than five times the practical quantitation limit (PQL), satisfactory precision is indicated by an RPD less than or equal to 25 percent for aqueous samples. Where one or both of the results of a field duplicate pair are reported at less than five times the PQL, satisfactory precision is indicated if the field duplicate results agree within 2.5 times the quantitation limit. Field duplicate results that do not meet these criteria may indicate unsatisfactory precision of the results.

One field duplicate sample was collected for the 7 investigative samples. This satisfies the requirement in the work plan (one per 10 investigative samples or 10 percent). All reported results for the field duplicate sample were in agreement with the above acceptance criteria.

## 8.0 INTERNAL STANDARD RESPONSES

Internal standard (IS) performance criteria ensure that the GC/MS sensitivity and response are stable during each analytical run. IS areas must be within -50 percent to +100 percent for VOCs and SVOCs. For the PCBs (Method 680), the IS areas must be within +/- 30 percent of the preceding calibration verification (CV) IS value. Also, the IS retention times must be within 30 seconds of the preceding IS CV retention time. If the IS area count is outside criteria, Method 680 indicates the mean IS area obtained during the initial calibration (ICAL) (+/- 50 percent) should be used.

The internal standards area responses for the VOCs, SVOCs and PCBs were verified for the data review. All IS responses met the criteria as described above, in all samples.

## 9.0 RESULTS REPORTED FROM DILUTIONS

Several VOC, SVOC and PCB samples were diluted and reanalyzed due to the original results exceeding the calibration range of the instrument. These results were qualified by the laboratory with "E" qualifiers. Data for the original runs were reported except for the data results that were "E" qualified. The samples that had "E" qualifiers were diluted and reanalyzed. The diluted sample results of the "E" qualifiers were the only results reported from the diluted samples.

**Appendix D**  
**Groundwater Analytical Results**

**SDG KPM001**

**Results of Samples from Wells:**

**PMA-3S**

**PMA-3M**

**PMA-1M**

**PMA-1S**

**PMA-2M**

**PMA-2S**



## ORGANIC DATA ASSESSMENT

PROJECT NUMBER: 21561601.00000 SITE: Solutia Krummrich  
 LABORATORY: STL Savannah  
 LAB PROJECT NO. 680-17992-1 REVIEWER: URS CORPORATION  
 NO. OF SAMPLES/ REVIEWER'S NAME: Tony Sedlacek  
 MATRIX: 17 samples/aqueous/8 filtered /8 unfiltered/ 1 Trip Blank  
 COMPLETION DATE: 8/24/2006

## DATA ASSESSMENT WORKSHEET

	VOCs Meth # 8260	SVOCs Meth # 8270	PCBs Meth # 680
1. HOLDING TIMES	✓	✓	✓
2. BLANKS	(1)	✓	✓
3. SURROGATES	✓	(5)	✓
4. SCS (LCS)	✓	✓	✓
5. DCS (LSCD)	N/A	N/A	N/A
6. MATRIX SPIKE/DUP	(2)	(6)	(9)
7. DILUTION	(3)	(7)	(10)
8. DUPLICATES	(4)	(8)	(11)
9. INTERNAL STANDARDS	✓	✓	(12)
10. OVERALL ASSESSMENT	O	O	O

O = Data had no problems/ or qualified due to minor problems.

M = Data qualified due to major problems.

Z = Data unacceptable.

X = Problems, but do not affect data.

**ACTION ITEMS:** (1) VOC analytes benzene (5.1 µg/L), 1,4-dichlorobenzene (6.8 µg/L), 1,2-dichlorobenzene (14 µg/L) and toluene (2.1 µg/L) were detected in equipment blank PMA3M-0606-EB. Sample results for analytes benzene (5.8 µg/L), 1,4-dichlorobenzene (14 µg/L) and 1,2-dichlorobenzene (27 µg/L) in sample PMA3S-0606 were less than 5X the equipment blank result and were qualified nondetect "U". (6) MS/MSD recoveries were outside evaluation criteria in sample PMA1M-0606 MS/MSD for bis(2-chloroethoxy)methane (147/127%) with criteria (55-115%), 4-chloroaniline (180/146%) with criteria (22-107%), 4-chloro-3-methylphenol (621/533%) with criteria (58-118%), and 4,6-dinitro-2-methylphenol (163/156%) with criteria (42-155%). MS recoveries were outside evaluation criteria for benzyl alcohol (121%) with criteria (54-116%), 2-chlorophenol (109%) with criteria (54-106%), 2,4-dichlorophenol (113%) with criteria (62-112%), 2,4-dimethylphenol (118%) with criteria (51-111%), isophorone (115%) with criteria (60-113%), and 2-methylphenol (113%) with criteria (57-110%). Although all other quality control parameters were within evaluation criteria the sample results between the parent sample and MS/MSD samples were different. All compounds except 4-chloroaniline were nondetect in the parent sample PMA1M-0606 and most compounds in the MS/MSD samples were detected. Professional judgment was used to qualify all detected analytes estimated "J" and all nondetects estimated nondetect "UJ" in sample PMA1M-0606 due to the uncertainty between the

**ACTION ITEMS CONTINUED:** parent and MS/MSD sample results. (9) Samples PMA1M-0606 and PMA1M-0606-F were spiked and analyzed for PCBs. MS/MSD recoveries for monochlorobiphenyl (-174/-179%) were outside evaluation criteria of (18-97%) in sample PMA1M-0606. Although all other quality control parameters were within evaluation criteria, the sample results between the parent sample and MS/MSD samples were different. All compounds were nondetect in the parent sample PMA1M-0606 and all but one compound in the MS/MSD samples were detected. Professional judgment was used to qualify all nondetects estimated nondetect "UJ" in sample PMA1M-0606 due to the uncertainty between the parent and MS/MSD sample results.

**COMMENTS:** (2) Eight out of the nine MS/MSD samples vials were received into the laboratory with headspace. The laboratory was contacted and stated that the amount of headspace in the samples were within specification and the samples were analyzed. MS/MSD recoveries for dichlorodifluoromethane (59/61%) were outside evaluation criteria (70-130%) in sample PMA1M-0606. All other quality control parameters were met, therefore no qualification of data were required. (3) Due to high levels of target analytes the following samples required primary dilutions: PMA3M-0606 (1:10), PMA1M-0606 (1:20), PMA1M-0606 MS (1:20), PMA1M-0606 MSD (1:20), PMA-2M-0606 (1:100) and PMA-2M-0606-AD (1:100), no qualification of data was required. (4) Sample PMA-2M-0606-AD was a duplicate of PMA-2M-0606 and all criteria were met, no qualification of data was required. (5) Surrogate recovery for phenol-d5 (111%) was outside evaluation criteria (55-104%) in sample PMA1M-0606MS, this is a matrix spike sample and qualifications are not made due to matrix spike samples alone. Surrogates 2-fluorobiphenyl, nitrobenzene-d5 and terphenyl-d14 were diluted out of sample PMA-2M-0606-AD, this was a field duplicate sample and all surrogates in the parent sample PMA-2M-0606 were within evaluation criteria, no qualification of data were required. (7) Due to high levels of target analytes the following sample required a primary dilution: PMA-2M-0606-AD (1:5), no qualification of data was required. (8) Sample PMA-2M-0606-AD was a duplicate of sample PMA-2M-0606 and analyzed for SVOCs, all evaluation criteria were met, no qualification of data was required. (10) Due to high levels of target analytes the following sample required a primary dilution: PMA-3M-0606 (1:2), no qualifications were required. (11) Sample PMA-2M-0606-AD was a duplicate of PMA-2M-0606 and PMA-2M-0606-AD-F was a duplicate of PMA-2M-0606-F, all evaluation criteria were met, no qualification of data was required. (12) Internal standard phenanthrene-d10 was outside evaluation criteria of  $\pm 30\%$  internal standard area in samples MB 680-49167, PMA3M-0606 and PMA1M-0606MSD. Internal standard chrysene-d12 was outside evaluation criteria of  $\pm 30\%$  internal standard area in samples MB 680-49167, PMA2S-0606 and PMA3M-0606. All internal standards were within  $+50\%$  of the average ICAL internal standard, therefore no qualification of data was required.

# **SAMPLE RESULTS**

# Analytical Data

Client: Solutia Inc.

Job Number: 680-18095-1

Sdg Number: KPM001

Client Sample ID: PMA3S-0606

Lab Sample ID: 680-18095-1

Date Sampled: 06/29/2006 1200

Client Matrix: Water

Date Received: 07/01/2006 0900

## 8260B Volatile Organic Compounds by GC/MS

Method: 8260B

Analysis Batch: 680-49512

Instrument ID: GC/MS Volatiles - O

Preparation: 5030B

Lab File ID: o047.d

Dilution: 1.0

Initial Weight/Volume: 5 mL

Date Analyzed: 07/10/2006 2259

Final Weight/Volume: 5 mL

Date Prepared: 07/10/2006 2259

Analyte	Result (ug/L)	Qualifier	RL
Acetone	25	U	25
Acetonitrile	40	U	40
Acrolein	20	U	20
Acrylonitrile	20	U	20
Benzene	5.8	"u"	1.0
Bromoform	1.0	U	1.0
Bromomethane	1.0	U	1.0
Carbon disulfide	2.0	U	2.0
Carbon tetrachloride	1.0	U	1.0
Chlorobenzene	7.8	U	1.0
2-Chloro-1,3-butadiene	1.0	U	1.0
Chlorodibromomethane	1.0	U	1.0
Chloroethane	1.0	U	1.0
Chloroform	1.0	U	1.0
Chloromethane	1.0	U	1.0
3-Chloro-1-propene	1.0	U	1.0
cis-1,3-Dichloropropene	1.0	U	1.0
1,2-Dibromo-3-Chloropropane	1.0	U	1.0
Dibromomethane	1.0	U	1.0
1,3-Dichlorobenzene	1.6	U	1.0
1,4-Dichlorobenzene	14	"u"	1.0
1,2-Dichlorobenzene	27	"u"	1.0
Dichlorobromomethane	1.0	U	1.0
Dichlorodifluoromethane	1.0	U	1.0
1,2-Dichloroethane	1.0	U	1.0
1,1-Dichloroethane	1.0	U	1.0
1,1-Dichloroethene	1.0	U	1.0
1,2-Dichloropropane	1.0	U	1.0
Ethylbenzene	1.0	U	1.0
Ethylene Dibromide	1.0	U	1.0
Ethyl methacrylate	1.0	U	1.0
2-Hexanone	10	U	10
Iodomethane	5.0	U	5.0
Isobutanol	40	U	40
Methacrylonitrile	20	U	20
Methylene Chloride	5.0	U	5.0
Methyl Ethyl Ketone	10	U	10
methyl isobutyl ketone	10	U	10
Methyl methacrylate	1.0	U	1.0
Pentachloroethane	5.0	U	5.0
Propionitrile	20	U	20
Styrene	1.0	U	1.0
1,1,2,2-Tetrachloroethane	1.0	U	1.0



**Analytical Data**

Client: Solutia Inc.

Job Number: 680-18095-1

Sdg Number: KPM001

Client Sample ID: PMA3S-0606

Lab Sample ID: 680-18095-1

Date Sampled: 06/29/2006 1200

Client Matrix: Water

Date Received: 07/01/2006 0900

**8260B Volatile Organic Compounds by GC/MS**

Method: 8260B

Analysis Batch: 680-49512

Instrument ID: GC/MS Volatiles - O

Preparation: 5030B

Lab File ID: o047.d

Dilution: 1.0

Initial Weight/Volume: 5 mL

Date Analyzed: 07/10/2006 2259

Final Weight/Volume: 5 mL

Date Prepared: 07/10/2006 2259

Analyte	Result (ug/L)	Qualifier	RL
1,1,1,2-Tetrachloroethane	1.0	U	1.0
Tetrachloroethene	1.0	U	1.0
Toluene	1.0	U	1.0
trans-1,4-Dichloro-2-butene	2.0	U	2.0
trans-1,2-Dichloroethene	1.0	U	1.0
trans-1,3-Dichloropropene	1.0	U	1.0
1,1,2-Trichloroethane	1.0	U	1.0
1,1,1-Trichloroethane	1.0	U	1.0
Trichloroethene	1.0	U	1.0
Trichlorofluoromethane	1.0	U	1.0
1,2,3-Trichloropropane	1.0	U	1.0
Vinyl acetate	2.0	U	2.0
Vinyl chloride	1.0	U	1.0
Xylenes, Total	2.0	U	2.0
Surrogate	%Rec	Acceptance Limits	
4-Bromofluorobenzene	93	77 - 120	
Dibromofluoromethane	95	75 - 123	
Toluene-d8	103	79 - 122	

**Analytical Data**

Client: Solutia Inc.

Job Number: 680-18095-1

Sdg Number: KPM001

Client Sample ID: PMA3M-0606-EB

Lab Sample ID: 680-18095-2EB

Date Sampled: 06/29/2006 1430

Client Matrix: Water

Date Received: 07/01/2006 0900

**8260B Volatile Organic Compounds by GC/MS**

Method: 8260B

Analysis Batch: 680-49512

Instrument ID: GC/MS Volatiles - O

Preparation: 5030B

Lab File ID: o043.d

Dilution: 1.0

Initial Weight/Volume: 5 mL

Date Analyzed: 07/10/2006 2202

Final Weight/Volume: 5 mL

Date Prepared: 07/10/2006 2202

Analyte	Result (ug/L)	Qualifier	RL
Acetone	25	U	25
Acetonitrile	40	U	40
Acrolein	20	U	20
Acrylonitrile	20	U	20
Benzene	5.1		1.0
Bromoform	1.0	U	1.0
Bromomethane	1.0	U	1.0
Carbon disulfide	2.0	U	2.0
Carbon tetrachloride	1.0	U	1.0
Chlorobenzene	2.1		1.0
2-Chloro-1,3-butadiene	1.0	U	1.0
Chlorodibromomethane	1.0	U	1.0
Chloroethane	1.0	U	1.0
Chloroform	1.0	U	1.0
Chloromethane	1.0	U	1.0
3-Chloro-1-propene	1.0	U	1.0
cis-1,3-Dichloropropene	1.0	U	1.0
1,2-Dibromo-3-Chloropropane	1.0	U	1.0
Dibromomethane	1.0	U	1.0
1,3-Dichlorobenzene	1.0	U	1.0
1,4-Dichlorobenzene	6.8		1.0
1,2-Dichlorobenzene	14		1.0
Dichlorobromomethane	1.0	U	1.0
Dichlorodifluoromethane	1.0	U	1.0
1,2-Dichloroethane	1.0	U	1.0
1,1-Dichloroethane	1.0	U	1.0
1,1-Dichloroethene	1.0	U	1.0
1,2-Dichloropropane	1.0	U	1.0
Ethylbenzene	1.0	U	1.0
Ethylene Dibromide	1.0	U	1.0
Ethyl methacrylate	1.0	U	1.0
2-Hexanone	10	U	10
Iodomethane	5.0	U	5.0
Isobutanol	40	U	40
Methacrylonitrile	20	U	20
Methylene Chloride	5.0	U	5.0
Methyl Ethyl Ketone	10	U	10
methyl isobutyl ketone	10	U	10
Methyl methacrylate	1.0	U	1.0
Pentachloroethane	5.0	U	5.0
Propionitrile	20	U	20
Styrene	1.0	U	1.0
1,1,2,2-Tetrachloroethane	1.0	U	1.0

**Analytical Data**

Client: Solutia Inc.

Job Number: 680-18095-1

Sdg Number: KPM001

Client Sample ID: PMA3M-0606-EB

Lab Sample ID: 680-18095-2EB

Client Matrix: Water

Date Sampled: 06/29/2006 1430

Date Received: 07/01/2006 0900

**8260B Volatile Organic Compounds by GC/MS**

Method: 8260B

Analysis Batch: 680-49512

Instrument ID: GC/MS Volatiles - O

Preparation: 5030B

Lab File ID: o043.d

Dilution: 1.0

Initial Weight/Volume: 5 mL

Date Analyzed: 07/10/2006 2202

Final Weight/Volume: 5 mL

Date Prepared: 07/10/2006 2202

Analyte	Result (ug/L)	Qualifier	RL
1,1,1,2-Tetrachloroethane	1.0	U	1.0
Tetrachloroethene	1.0	U	1.0
Toluene	2.1		1.0
trans-1,4-Dichloro-2-butene	2.0	U	2.0
trans-1,2-Dichloroethene	1.0	U	1.0
trans-1,3-Dichloropropene	1.0	U	1.0
1,1,2-Trichloroethane	1.0	U	1.0
1,1,1-Trichloroethane	1.0	U	1.0
Trichloroethene	1.0	U	1.0
Trichlorofluoromethane	1.0	U	1.0
1,2,3-Trichloropropane	1.0	U	1.0
Vinyl acetate	2.0	U	2.0
Vinyl chloride	1.0	U	1.0
Xylenes, Total	2.0	U	2.0
Surrogate	%Rec	Acceptance Limits	
4-Bromofluorobenzene	90	77 - 120	
Dibromofluoromethane	97	75 - 123	
Toluene-d8	103	79 - 122	



**Analytical Data**

Client: Solutia Inc.

Job Number: 680-18095-1

Sdg Number: KPM001

Client Sample ID: PMA3M-0606

Lab Sample ID: 680-18095-3

Client Matrix: Water

Date Sampled: 06/29/2006 1605

Date Received: 07/01/2006 0900

**8260B Volatile Organic Compounds by GC/MS**

Method: 8260B

Analysis Batch: 680-49512

Instrument ID: GC/MS Volatiles - O

Preparation: 5030B

Lab File ID: o049.d

Dilution: 10

Initial Weight/Volume: 5 mL

Date Analyzed: 07/10/2006 2328

Final Weight/Volume: 5 mL

Date Prepared: 07/10/2006 2328

Analyte	Result (ug/L)	Qualifier	RL
Acetone	250	U	250
Acetonitrile	400	U	400
Acrolein	200	U	200
Acrylonitrile	200	U	200
Benzene	1600		10
Bromoform	10	U	10
Bromomethane	10	U	10
Carbon disulfide	20	U	20
Carbon tetrachloride	10	U	10
Chlorobenzene	1300		10
2-Chloro-1,3-butadiene	10	U	10
Chlorodibromomethane	10	U	10
Chloroethane	10	U	10
Chloroform	10	U	10
Chloromethane	10	U	10
3-Chloro-1-propene	10	U	10
cis-1,3-Dichloropropene	10	U	10
1,2-Dibromo-3-Chloropropane	10	U	10
Dibromomethane	10	U	10
1,3-Dichlorobenzene	47		10
1,4-Dichlorobenzene	600		10
1,2-Dichlorobenzene	150		10
Dichlorobromomethane	10	U	10
Dichlorodifluoromethane	10	U	10
1,2-Dichloroethane	10	U	10
1,1-Dichloroethane	10	U	10
1,1-Dichloroethene	10	U	10
1,2-Dichloropropane	10	U	10
Ethylbenzene	110		10
Ethylene Dibromide	10	U	10
Ethyl methacrylate	10	U	10
2-Hexanone	100	U	100
Iodomethane	50	U	50
Isobutanol	400	U	400
Methacrylonitrile	200	U	200
Methylene Chloride	50	U	50
Methyl Ethyl Ketone	100	U	100
methyl isobutyl ketone	100	U	100
Methyl methacrylate	10	U	10
Pentachloroethane	50	U	50
Propionitrile	200	U	200
Styrene	10	U	10
1,1,2,2-Tetrachloroethane	10	U	10

**Analytical Data**

Client: Solutia Inc.

Job Number: 680-18095-1

Sdg Number: KPM001

Client Sample ID: PMA3M-0606

Lab Sample ID: 680-18095-3

Date Sampled: 06/29/2006 1605

Client Matrix: Water

Date Received: 07/01/2006 0900

**8260B Volatile Organic Compounds by GC/MS**

Method: 8260B

Analysis Batch: 680-49512

Instrument ID: GC/MS Volatiles - O

Preparation: 5030B

Lab File ID: o049.d

Dilution: 10

Initial Weight/Volume: 5 mL

Date Analyzed: 07/10/2006 2328

Final Weight/Volume: 5 mL

Date Prepared: 07/10/2006 2328

Analyte	Result (ug/L)	Qualifier	RL
1,1,1,2-Tetrachloroethane	10	U	10
Tetrachloroethene	10	U	10
Toluene	24		10
trans-1,4-Dichloro-2-butene	20	U	20
trans-1,2-Dichloroethene	10	U	10
trans-1,3-Dichloropropene	10	U	10
1,1,2-Trichloroethane	10	U	10
1,1,1-Trichloroethane	10	U	10
Trichloroethene	10	U	10
Trichlorofluoromethane	10	U	10
1,2,3-Trichloropropane	10	U	10
Vinyl acetate	20	U	20
Vinyl chloride	10	U	10
Xylenes, Total	350		20
Surrogate	%Rec	Acceptance Limits	
4-Bromofluorobenzene	93	77 - 120	
Dibromofluoromethane	94	75 - 123	
Toluene-d8	104	79 - 122	

**Analytical Data**

Client: Solutia Inc.

Job Number: 680-18095-1

Sdg Number: KPM001

Client Sample ID: PMA1M-0606

Lab Sample ID: 680-18095-4

Date Sampled: 06/29/2006 1145

Client Matrix: Water

Date Received: 07/01/2006 0900

**8260B Volatile Organic Compounds by GC/MS**

Method: 8260B

Analysis Batch: 680-49512

Instrument ID: GC/MS Volatiles - O

Preparation: 5030B

Lab File ID: o051.d

Dilution: 20

Initial Weight/Volume: 5 mL

Date Analyzed: 07/10/2006 2357

Final Weight/Volume: 5 mL

Date Prepared: 07/10/2006 2357

Analyte	Result (ug/L)	Qualifier	RL
Acetone	500	U	500
Acetonitrile	800	U	800
Acrolein	400	U	400
Acrylonitrile	400	U	400
Benzene	2500		20
Bromoform	20	U	20
Bromomethane	20	U	20
Carbon disulfide	40	U	40
Carbon tetrachloride	20	U	20
Chlorobenzene	1600		20
2-Chloro-1,3-butadiene	20	U	20
Chlorodibromomethane	20	U	20
Chloroethane	20	U	20
Chloroform	20	U	20
Chloromethane	20	U	20
3-Chloro-1-propene	20	U	20
cis-1,3-Dichloropropene	20	U	20
1,2-Dibromo-3-Chloropropane	20	U	20
Dibromomethane	20	U	20
1,2-Dichlorobenzene	20	U	20
1,3-Dichlorobenzene	20	U	20
1,4-Dichlorobenzene	20	U	20
Dichlorobromomethane	20	U	20
Dichlorodifluoromethane	20	U	20
1,2-Dichloroethane	20	U	20
1,1-Dichloroethane	20	U	20
1,1-Dichloroethene	20	U	20
1,2-Dichloropropane	20	U	20
Ethylbenzene	20	U	20
Ethylene Dibromide	20	U	20
Ethyl methacrylate	20	U	20
2-Hexanone	200	U	200
Iodomethane	100	U	100
Isobutanol	800	U	800
Methacrylonitrile	400	U	400
Methylene Chloride	100	U	100
Methyl Ethyl Ketone	200	U	200
methyl isobutyl ketone	200	U	200
Methyl methacrylate	20	U	20
Pentachloroethane	100	U	100
Propionitrile	400	U	400
Styrene	20	U	20
1,1,2,2-Tetrachloroethane	20	U	20



**Analytical Data**

Client: Solutia Inc.

Job Number: 680-18095-1

Sdg Number: KPM001

Client Sample ID: PMA1M-0606

Lab Sample ID: 680-18095-4

Date Sampled: 06/29/2006 1145

Client Matrix: Water

Date Received: 07/01/2006 0900

**8260B Volatile Organic Compounds by GC/MS**

Method: 8260B

Analysis Batch: 680-49512

Instrument ID: GC/MS Volatiles - O

Preparation: 5030B

Lab File ID: o051.d

Dilution: 20

Initial Weight/Volume: 5 mL

Date Analyzed: 07/10/2006 2357

Final Weight/Volume: 5 mL

Date Prepared: 07/10/2006 2357

Analyte	Result (ug/L)	Qualifier	RL
1,1,1,2-Tetrachloroethane	20	U	20
Tetrachloroethene	20	U	20
Toluene	20	U	20
trans-1,4-Dichloro-2-butene	40	U	40
trans-1,2-Dichloroethene	20	U	20
trans-1,3-Dichloropropene	20	U	20
1,1,2-Trichloroethane	20	U	20
1,1,1-Trichloroethane	20	U	20
Trichloroethene	20	U	20
Trichlorofluoromethane	20	U	20
1,2,3-Trichloropropane	20	U	20
Vinyl acetate	40	U	40
Vinyl chloride	20	U	20
Xylenes, Total	40	U	40
Surrogate	%Rec	Acceptance Limits	
4-Bromofluorobenzene	93	77 - 120	
Dibromofluoromethane	91	75 - 123	
Toluene-d8	104	79 - 122	

**Analytical Data**

Client: Solutia Inc.

Job Number: 680-18095-1

Sdg Number: KPM001

Client Sample ID: PMA1S-0606

Lab Sample ID: 680-18095-5

Client Matrix: Water

Date Sampled: 06/29/2006 1430

Date Received: 07/01/2006 0900

**8260B Volatile Organic Compounds by GC/MS**

Method: 8260B  
Preparation: 5030B  
Dilution: 1.0  
Date Analyzed: 07/11/2006 0153  
Date Prepared: 07/11/2006 0153

Analysis Batch: 680-49512

Instrument ID: GC/MS Volatiles - O

Lab File ID: o059.d

Initial Weight/Volume: 5 mL

Final Weight/Volume: 5 mL

Analyte	Result (ug/L)	Qualifier	RL
Acetone	25	U	25
Acetonitrile	40	U	40
Acrolein	20	U	20
Acrylonitrile	20	U	20
Benzene	1.0	U	1.0
Bromoform	1.0	U	1.0
Bromomethane	1.0	U	1.0
Carbon disulfide	2.0	U	2.0
Carbon tetrachloride	1.0	U	1.0
Chlorobenzene	1.0	U	1.0
2-Chloro-1,3-butadiene	1.0	U	1.0
Chlorodibromomethane	1.0	U	1.0
Chloroethane	1.0	U	1.0
Chloroform	1.0	U	1.0
Chloromethane	1.0	U	1.0
3-Chloro-1-propene	1.0	U	1.0
cis-1,3-Dichloropropene	1.0	U	1.0
1,2-Dibromo-3-Chloropropane	1.0	U	1.0
Dibromomethane	1.0	U	1.0
1,2-Dichlorobenzene	1.0	U	1.0
1,3-Dichlorobenzene	1.0	U	1.0
1,4-Dichlorobenzene	1.0	U	1.0
Dichlorobromomethane	1.0	U	1.0
Dichlorodifluoromethane	1.0	U	1.0
1,2-Dichloroethane	1.0	U	1.0
1,1-Dichloroethane	1.0	U	1.0
1,1-Dichloroethene	1.0	U	1.0
1,2-Dichloropropane	1.0	U	1.0
Ethylbenzene	1.0	U	1.0
Ethylene Dibromide	1.0	U	1.0
Ethyl methacrylate	1.0	U	1.0
2-Hexanone	10	U	10
Iodomethane	5.0	U	5.0
Isobutanol	40	U	40
Methacrylonitrile	20	U	20
Methylene Chloride	5.0	U	5.0
Methyl Ethyl Ketone	10	U	10
methyl isobutyl ketone	10	U	10
Methyl methacrylate	1.0	U	1.0
Pentachloroethane	5.0	U	5.0
Propionitrile	20	U	20
Styrene	1.0	U	1.0
1,1,2,2-Tetrachloroethane	1.0	U	1.0

**Analytical Data**

Client: Solutia Inc.

Job Number: 680-18095-1

Sdg Number: KPM001

Client Sample ID: PMA1S-0606

Lab Sample ID: 680-18095-5

Client Matrix: Water

Date Sampled: 06/29/2006 1430

Date Received: 07/01/2006 0900

**8260B Volatile Organic Compounds by GC/MS**

Method: 8260B

Analysis Batch: 680-49512

Instrument ID: GC/MS Volatiles - O

Preparation: 5030B

Lab File ID: o059.d

Dilution: 1.0

Initial Weight/Volume: 5 mL

Date Analyzed: 07/11/2006 0153

Final Weight/Volume: 5 mL

Date Prepared: 07/11/2006 0153

Analyte	Result (ug/L)	Qualifier	RL
1,1,1,2-Tetrachloroethane	1.0	U	1.0
Tetrachloroethene	1.0	U	1.0
Toluene	1.0	U	1.0
trans-1,4-Dichloro-2-butene	2.0	U	2.0
trans-1,2-Dichloroethene	1.0	U	1.0
trans-1,3-Dichloropropene	1.0	U	1.0
1,1,2-Trichloroethane	1.0	U	1.0
1,1,1-Trichloroethane	1.0	U	1.0
Trichloroethene	1.0	U	1.0
Trichlorofluoromethane	1.0	U	1.0
1,2,3-Trichloropropane	1.0	U	1.0
Vinyl acetate	2.0	U	2.0
Vinyl chloride	1.0	U	1.0
Xylenes, Total	2.0	U	2.0
Surrogate	%Rec	Acceptance Limits	
4-Bromofluorobenzene	90	77 - 120	
Dibromofluoromethane	96	75 - 123	
Toluene-d8	101	79 - 122	



**Analytical Data**

Client: Solutia Inc.

Job Number: 680-18095-1

Sdg Number: KPM001

Client Sample ID: TB-6

Lab Sample ID: 680-18095-6TB

Date Sampled: 06/29/2006 0000

Client Matrix: Water

Date Received: 07/01/2006 0900

**8260B Volatile Organic Compounds by GC/MS**

Method: 8260B

Analysis Batch: 680-49512

Instrument ID: GC/MS Volatiles - O

Preparation: 5030B

Lab File ID: o045.d

Dilution: 1.0

Initial Weight/Volume: 5 mL

Date Analyzed: 07/10/2006 2230

Final Weight/Volume: 5 mL

Date Prepared: 07/10/2006 2230

Analyte	Result (ug/L)	Qualifier	RL
Acetone	25	U	25
Acetonitrile	40	U	40
Acrolein	20	U	20
Acrylonitrile	20	U	20
Benzene	1.0	U	1.0
Bromoform	1.0	U	1.0
Bromomethane	1.0	U	1.0
Carbon disulfide	2.0	U	2.0
Carbon tetrachloride	1.0	U	1.0
Chlorobenzene	1.0	U	1.0
2-Chloro-1,3-butadiene	1.0	U	1.0
Chlorodibromomethane	1.0	U	1.0
Chloroethane	1.0	U	1.0
Chloroform	1.0	U	1.0
Chloromethane	1.0	U	1.0
3-Chloro-1-propene	1.0	U	1.0
cis-1,3-Dichloropropene	1.0	U	1.0
1,2-Dibromo-3-Chloropropane	1.0	U	1.0
Dibromomethane	1.0	U	1.0
1,2-Dichlorobenzene	1.0	U	1.0
1,3-Dichlorobenzene	1.0	U	1.0
1,4-Dichlorobenzene	1.0	U	1.0
Dichlorobromomethane	1.0	U	1.0
Dichlorodifluoromethane	1.0	U	1.0
1,2-Dichloroethane	1.0	U	1.0
1,1-Dichloroethane	1.0	U	1.0
1,1-Dichloroethene	1.0	U	1.0
1,2-Dichloropropane	1.0	U	1.0
Ethylbenzene	1.0	U	1.0
Ethylene Dibromide	1.0	U	1.0
Ethyl methacrylate	1.0	U	1.0
2-Hexanone	10	U	10
Iodomethane	5.0	U	5.0
Isobutanol	40	U	40
Methacrylonitrile	20	U	20
Methylene Chloride	5.0	U	5.0
Methyl Ethyl Ketone	10	U	10
methyl isobutyl ketone	10	U	10
Methyl methacrylate	1.0	U	1.0
Pentachloroethane	5.0	U	5.0
Propionitrile	20	U	20
Styrene	1.0	U	1.0
1,1,2,2-Tetrachloroethane	1.0	U	1.0

**Analytical Data**

Client: Solutia Inc.

Job Number: 680-18095-1

Sdg Number: KPM001

Client Sample ID: TB-6

Lab Sample ID: 680-18095-6TB

Date Sampled: 06/29/2006 0000

Client Matrix: Water

Date Received: 07/01/2006 0900

**8260B Volatile Organic Compounds by GC/MS**

Method: 8260B

Analysis Batch: 680-49512

Instrument ID: GC/MS Volatiles - O

Preparation: 5030B

Lab File ID: o045.d

Dilution: 1.0

Initial Weight/Volume: 5 mL

Date Analyzed: 07/10/2006 2230

Final Weight/Volume: 5 mL

Date Prepared: 07/10/2006 2230

Analyte	Result (ug/L)	Qualifier	RL
1,1,1,2-Tetrachloroethane	1.0	U	1.0
Tetrachloroethene	1.0	U	1.0
Toluene	1.0	U	1.0
trans-1,4-Dichloro-2-butene	2.0	U	2.0
trans-1,2-Dichloroethene	1.0	U	1.0
trans-1,3-Dichloropropene	1.0	U	1.0
1,1,2-Trichloroethane	1.0	U	1.0
1,1,1-Trichloroethane	1.0	U	1.0
Trichloroethene	1.0	U	1.0
Trichlorofluoromethane	1.0	U	1.0
1,2,3-Trichloropropane	1.0	U	1.0
Vinyl acetate	2.0	U	2.0
Vinyl chloride	1.0	U	1.0
Xylenes, Total	2.0	U	2.0

Surrogate	%Rec	Acceptance Limits
4-Bromofluorobenzene	90	77 - 120
Dibromofluoromethane	101	75 - 123
Toluene-d8	104	79 - 122

**Analytical Data**

Client: Solutia Inc.

Job Number: 680-18095-1

Sdg Number: KPM001

Client Sample ID: PMA-2M-0606

Lab Sample ID: 680-18095-7

Date Sampled: 06/29/2006 1700

Client Matrix: Water

Date Received: 07/01/2006 0900

**8260B Volatile Organic Compounds by GC/MS**

Method: 8260B  
Preparation: 5030B  
Dilution: 100  
Date Analyzed: 07/11/2006 0222  
Date Prepared: 07/11/2006 0222

Analysis Batch: 680-49512

Instrument ID: GC/MS Volatiles - O

Lab File ID: o061.d

Initial Weight/Volume: 5 mL

Final Weight/Volume: 5 mL

Analyte	Result (ug/L)	Qualifier	RL
Acetone	2500	U	2500
Acetonitrile	4000	U	4000
Acrolein	2000	U	2000
Acrylonitrile	2000	U	2000
Benzene	4400		100
Bromoform	100	U	100
Bromomethane	100	U	100
Carbon disulfide	200	U	200
Carbon tetrachloride	100	U	100
Chlorobenzene	11000		100
2-Chloro-1,3-butadiene	100	U	100
Chlorodibromomethane	100	U	100
Chloroethane	100	U	100
Chloroform	100	U	100
Chloromethane	100	U	100
3-Chloro-1-propene	100	U	100
cis-1,3-Dichloropropene	100	U	100
1,2-Dibromo-3-Chloropropane	100	U	100
Dibromomethane	100	U	100
1,2-Dichlorobenzene	100	U	100
1,3-Dichlorobenzene	100	U	100
1,4-Dichlorobenzene	100	U	100
Dichlorobromomethane	100	U	100
Dichlorodifluoromethane	100	U	100
1,2-Dichloroethane	100	U	100
1,1-Dichloroethane	100	U	100
1,1-Dichloroethene	100	U	100
1,2-Dichloropropane	100	U	100
Ethylbenzene	100	U	100
Ethylene Dibromide	100	U	100
Ethyl methacrylate	100	U	100
2-Hexanone	1000	U	1000
Iodomethane	500	U	500
Isobutanol	4000	U	4000
Methacrylonitrile	2000	U	2000
Methylene Chloride	500	U	500
Methyl Ethyl Ketone	1000	U	1000
methyl isobutyl ketone	1000	U	1000
Methyl methacrylate	100	U	100
Pentachloroethane	500	U	500
Propionitrile	2000	U	2000
Styrene	100	U	100
1,1,2,2-Tetrachloroethane	100	U	100



**Analytical Data**

Client: Solutia Inc.

Job Number: 680-18095-1

Sdg Number: KPM001

Client Sample ID: PMA-2M-0606

Lab Sample ID: 680-18095-7

Client Matrix: Water

Date Sampled: 06/29/2006 1700

Date Received: 07/01/2006 0900

**8260B Volatile Organic Compounds by GC/MS**

Method: 8260B

Analysis Batch: 680-49512

Instrument ID: GC/MS Volatiles - O

Preparation: 5030B

Lab File ID: o061.d

Dilution: 100

Initial Weight/Volume: 5 mL

Date Analyzed: 07/11/2006 0222

Final Weight/Volume: 5 mL

Date Prepared: 07/11/2006 0222

Analyte	Result (ug/L)	Qualifier	RL
1,1,1,2-Tetrachloroethane	100	U	100
Tetrachloroethene	100	U	100
Toluene	100	U	100
trans-1,4-Dichloro-2-butene	200	U	200
trans-1,2-Dichloroethene	100	U	100
trans-1,3-Dichloropropene	100	U	100
1,1,2-Trichloroethane	100	U	100
1,1,1-Trichloroethane	100	U	100
Trichloroethene	100	U	100
Trichlorofluoromethane	100	U	100
1,2,3-Trichloropropane	100	U	100
Vinyl acetate	200	U	200
Vinyl chloride	100	U	100
Xylenes, Total	200	U	200
Surrogate	%Rec		Acceptance Limits
4-Bromofluorobenzene	92		77 - 120
Dibromofluoromethane	94		75 - 123
Toluene-d8	106		79 - 122

**Analytical Data**

Client: Solutia Inc.

Job Number: 680-18095-1

Sdg Number: KPM001

Client Sample ID: PMA-2M-0606-AD

Lab Sample ID: 680-18095-8FD

Client Matrix: Water

Date Sampled: 06/29/2006 1700

Date Received: 07/01/2006 0900

**8260B Volatile Organic Compounds by GC/MS**

Method: 8260B

Analysis Batch: 680-49512

Instrument ID: GC/MS Volatiles - O

Preparation: 5030B

Lab File ID: o063.d

Dilution: 100

Initial Weight/Volume: 5 mL

Date Analyzed: 07/11/2006 0251

Final Weight/Volume: 5 mL

Date Prepared: 07/11/2006 0251

Analyte	Result (ug/L)	Qualifier	RL
Acetone	2500	U	2500
Acetonitrile	4000	U	4000
Acrolein	2000	U	2000
Acrylonitrile	2000	U	2000
Benzene	4300		100
Bromoform	100	U	100
Bromomethane	100	U	100
Carbon disulfide	200	U	200
Carbon tetrachloride	100	U	100
Chlorobenzene	11000		100
2-Chloro-1,3-butadiene	100	U	100
Chlorodibromomethane	100	U	100
Chloroethane	100	U	100
Chloroform	100	U	100
Chloromethane	100	U	100
3-Chloro-1-propene	100	U	100
cis-1,3-Dichloropropene	100	U	100
1,2-Dibromo-3-Chloropropane	100	U	100
Dibromomethane	100	U	100
1,2-Dichlorobenzene	100	U	100
1,3-Dichlorobenzene	100	U	100
1,4-Dichlorobenzene	100	U	100
Dichlorobromomethane	100	U	100
Dichlorodifluoromethane	100	U	100
1,2-Dichloroethane	100	U	100
1,1-Dichloroethane	100	U	100
1,1-Dichloroethene	100	U	100
1,2-Dichloropropane	100	U	100
Ethylbenzene	100	U	100
Ethylene Dibromide	100	U	100
Ethyl methacrylate	100	U	100
2-Hexanone	1000	U	1000
Iodomethane	500	U	500
Isobutanol	4000	U	4000
Methacrylonitrile	2000	U	2000
Methylene Chloride	500	U	500
Methyl Ethyl Ketone	1000	U	1000
methyl isobutyl ketone	1000	U	1000
Methyl methacrylate	100	U	100
Pentachloroethane	500	U	500
Propionitrile	2000	U	2000
Styrene	100	U	100
1,1,2,2-Tetrachloroethane	100	U	100

**Analytical Data**

Client: Solutia Inc.

Job Number: 680-18095-1

Sdg Number: KPM001

Client Sample ID: PMA-2M-0606-AD

Lab Sample ID: 680-18095-8FD

Date Sampled: 06/29/2006 1700

Client Matrix: Water

Date Received: 07/01/2006 0900

**8260B Volatile Organic Compounds by GC/MS**

Method: 8260B

Analysis Batch: 680-49512

Instrument ID: GC/MS Volatiles - O

Preparation: 5030B

Lab File ID: o063.d

Dilution: 100

Initial Weight/Volume: 5 mL

Date Analyzed: 07/11/2006 0251

Final Weight/Volume: 5 mL

Date Prepared: 07/11/2006 0251

Analyte	Result (ug/L)	Qualifier	RL
1,1,1,2-Tetrachloroethane	100	U	100
Tetrachloroethene	100	U	100
Toluene	100	U	100
trans-1,4-Dichloro-2-butene	200	U	200
trans-1,2-Dichloroethene	100	U	100
trans-1,3-Dichloropropene	100	U	100
1,1,2-Trichloroethane	100	U	100
1,1,1-Trichloroethane	100	U	100
Trichloroethene	100	U	100
Trichlorofluoromethane	100	U	100
1,2,3-Trichloropropane	100	U	100
Vinyl acetate	200	U	200
Vinyl chloride	100	U	100
Xylenes, Total	200	U	200

Surrogate	%Rec	Acceptance Limits
4-Bromofluorobenzene	93	77 - 120
Dibromofluoromethane	94	75 - 123
Toluene-d8	103	79 - 122

**Analytical Data**

Client: Solutia Inc.

Job Number: 680-18095-1

Sdg Number: KPM001

Client Sample ID: PMA2S-0606

Lab Sample ID: 680-18095-11

Date Sampled: 06/30/2006 0845

Client Matrix: Water

Date Received: 07/01/2006 0900

**8260B Volatile Organic Compounds by GC/MS**

Method: 8260B

Analysis Batch: 680-49637

Instrument ID: GC/MS Volatiles - O

Preparation: 5030B

Lab File ID: o089.d

Dilution: 1.0

Initial Weight/Volume: 5 mL

Date Analyzed: 07/12/2006 0129

Final Weight/Volume: 5 mL

Date Prepared: 07/12/2006 0129

Analyte	Result (ug/L)	Qualifier	RL
Acetone	25	U	25
Acetonitrile	40	U	40
Acrolein	20	U	20
Acrylonitrile	20	U	20
Benzene	1.0	U	1.0
Bromoform	1.0	U	1.0
Bromomethane	1.0	U	1.0
Carbon disulfide	2.0	U	2.0
Carbon tetrachloride	1.0	U	1.0
Chlorobenzene	1.0	U	1.0
2-Chloro-1,3-butadiene	1.0	U	1.0
Chlorodibromomethane	1.0	U	1.0
Chloroethane	1.0	U	1.0
Chloroform	3.4	U	1.0
Chloromethane	1.0	U	1.0
3-Chloro-1-propene	1.0	U	1.0
cis-1,3-Dichloropropene	1.0	U	1.0
1,2-Dibromo-3-Chloropropane	1.0	U	1.0
Dibromomethane	1.0	U	1.0
1,2-Dichlorobenzene	1.0	U	1.0
1,3-Dichlorobenzene	1.0	U	1.0
1,4-Dichlorobenzene	1.0	U	1.0
Dichlorobromomethane	1.0	U	1.0
Dichlorodifluoromethane	1.0	U	1.0
1,2-Dichloroethane	1.0	U	1.0
1,1-Dichloroethane	1.0	U	1.0
1,1-Dichloroethene	1.0	U	1.0
1,2-Dichloropropane	1.0	U	1.0
Ethylbenzene	1.0	U	1.0
Ethylene Dibromide	1.0	U	1.0
Ethyl methacrylate	1.0	U	1.0
2-Hexanone	10	U	10
Iodomethane	5.0	U	5.0
Isobutanol	40	U	40
Methacrylonitrile	20	U	20
Methylene Chloride	5.0	U	5.0
Methyl Ethyl Ketone	10	U	10
methyl isobutyl ketone	10	U	10
Methyl methacrylate	1.0	U	1.0
Pentachloroethane	5.0	U	5.0
Propionitrile	20	U	20
Styrene	1.0	U	1.0
1,1,2,2-Tetrachloroethane	1.0	U	1.0



**Analytical Data**

Client: Solutia Inc.

Job Number: 680-18095-1

Sdg Number: KPM001

Client Sample ID: PMA2S-0606

Lab Sample ID: 680-18095-11

Client Matrix: Water

Date Sampled: 06/30/2006 0845

Date Received: 07/01/2006 0900

**8260B Volatile Organic Compounds by GC/MS**

Method: 8260B

Analysis Batch: 680-49637

Instrument ID: GC/MS Volatiles - O

Preparation: 5030B

Lab File ID: o089.d

Dilution: 1.0

Initial Weight/Volume: 5 mL

Date Analyzed: 07/12/2006 0129

Final Weight/Volume: 5 mL

Date Prepared: 07/12/2006 0129

Analyte	Result (ug/L)	Qualifier	RL
1,1,1,2-Tetrachloroethane	1.0	U	1.0
Tetrachloroethene	1.0	U	1.0
Toluene	1.0	U	1.0
trans-1,4-Dichloro-2-butene	2.0	U	2.0
trans-1,2-Dichloroethene	1.0	U	1.0
trans-1,3-Dichloropropene	1.0	U	1.0
1,1,2-Trichloroethane	1.0	U	1.0
1,1,1-Trichloroethane	1.0	U	1.0
Trichloroethene	1.0	U	1.0
Trichlorofluoromethane	1.0	U	1.0
1,2,3-Trichloropropane	1.0	U	1.0
Vinyl acetate	2.0	U	2.0
Vinyl chloride	1.0	U	1.0
Xylenes, Total	2.0	U	2.0
Surrogate	%Rec	Acceptance Limits	
4-Bromofluorobenzene	94	77 - 120	
Dibromofluoromethane	107	75 - 123	
Toluene-d8	104	79 - 122	

## Analytical Data

Client: Solutia Inc.

Job Number: 680-18095-1

Sdg Number: KPM001

Client Sample ID: PMA3S-0606

Lab Sample ID: 680-18095-1

Date Sampled: 06/29/2006 1200

Client Matrix: Water

Date Received: 07/01/2006 0900

### 680 Polychlorinated Biphenyls by GCMS

Method: 680

Analysis Batch: 680-50316

Instrument ID: GC/MS SemiVolatiles - F

Preparation: 680\_P\_Liquid

Prep Batch: 680-49167

Lab File ID: N/A

Dilution: 1.0

Initial Weight/Volume: 1050 mL

Date Analyzed: 07/14/2006 1221

Final Weight/Volume: 1 mL

Date Prepared: 07/05/2006 1400

Injection Volume:

Analyte	Result (ug/L)	Qualifier	RL
Monochlorobiphenyl	0.54		0.095
Dichlorobiphenyl	0.12		0.095
Trichlorobiphenyl	0.095	U	0.095
Tetrachlorobiphenyl	0.19	U	0.19
Pentachlorobiphenyl	0.19	U	0.19
Hexachlorobiphenyl	0.19	U	0.19
Heptachlorobiphenyl	0.29	U	0.29
Octachlorobiphenyl	0.29	U	0.29
Nonachlorobiphenyl	0.48	U	0.48
DCB, Decachlorobiphenyl	0.48	U	0.48
Surrogate	%Rec		Acceptance Limits
Decachlorobiphenyl-13C12	85		44 - 104

**Analytical Data**

Client: Solutia Inc.

Job Number: 680-18095-1

Sdg Number: KPM001

Client Sample ID: PMA3M-0606-EB

Lab Sample ID: 680-18095-2EB

Date Sampled: 06/29/2006 1430

Client Matrix: Water

Date Received: 07/01/2006 0900

**680 Polychlorinated Biphenyls by GCMS**

Method:	680	Analysis Batch:	680-50316	Instrument ID:	GC/MS SemiVolatiles - F
Preparation:	680_P_Liquid	Prep Batch:	680-49167	Lab File ID:	N/A
Dilution:	1.0			Initial Weight/Volume:	1050 mL
Date Analyzed:	07/14/2006 1255			Final Weight/Volume:	1 mL
Date Prepared:	07/05/2006 1400			Injection Volume:	

Analyte	Result (ug/L)	Qualifier	RL
Monochlorobiphenyl	0.095	U	0.095
Dichlorobiphenyl	0.095	U	0.095
Trichlorobiphenyl	0.095	U	0.095
Tetrachlorobiphenyl	0.19	U	0.19
Pentachlorobiphenyl	0.19	U	0.19
Hexachlorobiphenyl	0.19	U	0.19
Heptachlorobiphenyl	0.29	U	0.29
Octachlorobiphenyl	0.29	U	0.29
Nonachlorobiphenyl	0.48	U	0.48
DCB Decachlorobiphenyl	0.48	U	0.48
Surrogate	%Rec		Acceptance Limits
Decachlorobiphenyl-13C12	74		44 - 104

## Analytical Data

Client: Solutia Inc.

Job Number: 680-18095-1

Sdg Number: KPM001

Client Sample ID: PMA3M-0606

Lab Sample ID: 680-18095-3

Client Matrix: Water

Date Sampled: 06/29/2006 1605

Date Received: 07/01/2006 0900

### 680 Polychlorinated Biphenyls by GCMS

Method: 680  
Preparation: 680\_P\_Liquid  
Dilution: 1.0  
Date Analyzed: 07/14/2006 1329  
Date Prepared: 07/05/2006 1400

Analysis Batch: 680-50316  
Prep Batch: 680-49167

Instrument ID: GC/MS SemiVolatiles - F  
Lab File ID: N/A  
Initial Weight/Volume: 1050 mL  
Final Weight/Volume: 1 mL  
Injection Volume:

Analyte	Result (ug/L)	Qualifier	RL
Monochlorobiphenyl	6.7	E	0.095 *
Dichlorobiphenyl	0.68		0.095
Trichlorobiphenyl	0.095	U	0.095
Tetrachlorobiphenyl	0.19	U	0.19
Pentachlorobiphenyl	0.19	U	0.19
Hexachlorobiphenyl	0.19	U	0.19
Heptachlorobiphenyl	0.29	U	0.29
Octachlorobiphenyl	0.29	U	0.29
Nonachlorobiphenyl	0.48	U	0.48
DCB Decachlorobiphenyl	0.48	U	0.48
Surrogate	%Rec		Acceptance Limits
Decachlorobiphenyl-13C12	67		44 - 104

\* see page 28



**Analytical Data**

Client: Solutia Inc.

Job Number: 680-18095-1

Sdg Number: KPM001

Client Sample ID: PMA3M-0606

Lab Sample ID: 680-18095-3

Client Matrix: Water

Date Sampled: 06/29/2006 1605

Date Received: 07/01/2006 0900

**680 Polychlorinated Biphenyls by GCMS**

Method:	680	Analysis Batch:	680-50316	Instrument ID:	GC/MS SemiVolatiles - F
Preparation:	680_P_Liquid	Prep Batch:	680-49167	Lab File ID:	N/A
Dilution:	2.0			Initial Weight/Volume:	1050 mL
Date Analyzed:	07/17/2006 1317	Run Type:	DL	Final Weight/Volume:	1 mL
Date Prepared:	07/05/2006 1400			Injection Volume:	

Analyte	Result (ug/L)	Qualifier	RL
Monochlorobiphenyl	4.5	D	0.19
Dichlorobiphenyl	0.52	D	0.19 *
Trichlorobiphenyl	0.19	U	0.19 *
Tetrachlorobiphenyl	0.38	U	0.38 *
Pentachlorobiphenyl	0.38	U	0.38 *
Hexachlorobiphenyl	0.38	U	0.38 *
Heptachlorobiphenyl	0.57	U	0.57 *
Octachlorobiphenyl	0.57	U	0.57 *
Nonachlorobiphenyl	0.95	U	0.95 *
DCB Decachlorobiphenyl	0.95	U	0.95 *
Surrogate	%Rec		Acceptance Limits
Decachlorobiphenyl-13C12	63		44 - 104

\* see page 27

## Analytical Data

Client: Solutia Inc.

Job Number: 680-18095-1

Sdg Number: KPM001

Client Sample ID: PMA1M-0606

Lab Sample ID: 680-18095-4

Client Matrix: Water

Date Sampled: 06/29/2006 1145

Date Received: 07/01/2006 0900

### 680 Polychlorinated Biphenyls by GCMS

Method: 680

Analysis Batch: 680-50316

Instrument ID: GC/MS SemiVolatiles - F

Preparation: 680\_P\_Liquid

Prep Batch: 680-49167

Lab File ID: N/A

Dilution: 1.0

Initial Weight/Volume: 1060 mL

Date Analyzed: 07/14/2006 1402

Final Weight/Volume: 1 mL

Date Prepared: 07/05/2006 1400

Injection Volume:

Analyte	Result (ug/L)	Qualifier	RL
Monochlorobiphenyl	0.094	U "uJ"	0.094
Dichlorobiphenyl	0.094	U	0.094
Trichlorobiphenyl	0.094	U	0.094
Tetrachlorobiphenyl	0.19	U	0.19
Pentachlorobiphenyl	0.19	U	0.19
Hexachlorobiphenyl	0.19	U	0.19
Heptachlorobiphenyl	0.28	U	0.28
Octachlorobiphenyl	0.28	U	0.28
Nonachlorobiphenyl	0.47	U	0.47
DCB Decachlorobiphenyl	0.47	U "uJ"	0.47
Surrogate	%Rec		Acceptance Limits
Decachlorobiphenyl-13C12	64		44 - 104

**Analytical Data**

Client: Solutia Inc.

Job Number: 680-18095-1

Sdg Number: KPM001

Client Sample ID: PMA1S-0606

Lab Sample ID: 680-18095-5

Client Matrix: Water

Date Sampled: 06/29/2006 1430

Date Received: 07/01/2006 0900

**680 Polychlorinated Biphenyls by GCMS**

Method:	680	Analysis Batch:	680-50316	Instrument ID:	GC/MS SemiVolatiles - F
Preparation:	680_P_Liquid	Prep Batch:	680-49167	Lab File ID:	N/A
Dilution:	1.0			Initial Weight/Volume:	1060 mL
Date Analyzed:	07/14/2006 1436			Final Weight/Volume:	1 mL
Date Prepared:	07/05/2006 1400			Injection Volume:	

Analyte	Result (ug/L)	Qualifier	RL
Monochlorobiphenyl	0.094	U	0.094
Dichlorobiphenyl	0.094	U	0.094
Trichlorobiphenyl	0.094	U	0.094
Tetrachlorobiphenyl	0.19	U	0.19
Pentachlorobiphenyl	0.19	U	0.19
Hexachlorobiphenyl	0.19	U	0.19
Heptachlorobiphenyl	0.28	U	0.28
Octachlorobiphenyl	0.28	U	0.28
Nonachlorobiphenyl	0.47	U	0.47
DCB Decachlorobiphenyl	0.47	U	0.47
Surrogate	%Rec		Acceptance Limits
Decachlorobiphenyl-13C12	85		44 - 104

**Analytical Data**

Client: Solutia Inc.

Job Number: 680-18095-1

Sdg Number: KPM001

Client Sample ID: PMA-2M-0606

Lab Sample ID: 680-18095-7

Client Matrix: Water

Date Sampled: 06/29/2006 1700

Date Received: 07/01/2006 0900

**680 Polychlorinated Biphenyls by GCMS**

Method: 680

Analysis Batch: 680-50316

Instrument ID: GC/MS SemiVolatiles - F

Preparation: 680\_P\_Liquid

Prep Batch: 680-49167

Lab File ID: N/A

Dilution: 1.0

Initial Weight/Volume: 1060 mL

Date Analyzed: 07/14/2006 1510

Final Weight/Volume: 1 mL

Date Prepared: 07/05/2006 1400

Injection Volume:

Analyte	Result (ug/L)	Qualifier	RL
Monochlorobiphenyl	2.1		0.094
Dichlorobiphenyl	0.094	U	0.094
Trichlorobiphenyl	0.094	U	0.094
Tetrachlorobiphenyl	0.19	U	0.19
Pentachlorobiphenyl	0.19	U	0.19
Hexachlorobiphenyl	0.19	U	0.19
Heptachlorobiphenyl	0.28	U	0.28
Octachlorobiphenyl	0.28	U	0.28
Nonachlorobiphenyl	0.47	U	0.47
DCB Decachlorobiphenyl	0.47	U	0.47
Surrogate	%Rec		Acceptance Limits
Decachlorobiphenyl-13C12	68		44 - 104



**Analytical Data**

Client: Solutia Inc.

Job Number: 680-18095-1

Sdg Number: KPM001

Client Sample ID: PMA-2M-0606-AD

Lab Sample ID: 680-18095-8FD

Date Sampled: 06/29/2006 1700

Client Matrix: Water

Date Received: 07/01/2006 0900

**680 Polychlorinated Biphenyls by GCMS**

Method:	680	Analysis Batch:	680-50316	Instrument ID:	GC/MS SemiVolatiles - F
Preparation:	680_P_Liquid	Prep Batch:	680-49167	Lab File ID:	N/A
Dilution:	1.0			Initial Weight/Volume:	1060 mL
Date Analyzed:	07/14/2006 1544			Final Weight/Volume:	1 mL
Date Prepared:	07/05/2006 1400			Injection Volume:	

Analyte	Result (ug/L)	Qualifier	RL
Monochlorobiphenyl	2.3		0.094
Dichlorobiphenyl	0.094	U	0.094
Trichlorobiphenyl	0.094	U	0.094
Tetrachlorobiphenyl	0.19	U	0.19
Pentachlorobiphenyl	0.19	U	0.19
Hexachlorobiphenyl	0.19	U	0.19
Heptachlorobiphenyl	0.28	U	0.28
Octachlorobiphenyl	0.28	U	0.28
Nonachlorobiphenyl	0.47	U	0.47
DCB Decachlorobiphenyl	0.47	U	0.47
Surrogate	%Rec		Acceptance Limits
Decachlorobiphenyl-13C12	69		44 - 104

## Analytical Data

Client: Solutia Inc.

Job Number: 680-18095-1

Sdg Number: KPM001

Client Sample ID: PMA2S-0606

Lab Sample ID: 680-18095-11

Client Matrix: Water

Date Sampled: 06/30/2006 0845

Date Received: 07/01/2006 0900

### 680 Polychlorinated Biphenyls by GCMS

Method: 680

Analysis Batch: 680-50316

Instrument ID: GC/MS SemiVolatiles - F

Preparation: 680\_P\_Liquid

Prep Batch: 680-49167

Lab File ID: N/A

Dilution: 1.0

Initial Weight/Volume: 1060 mL

Date Analyzed: 07/14/2006 1617

Final Weight/Volume: 1 mL

Date Prepared: 07/05/2006 1400

Injection Volume:

Analyte	Result (ug/L)	Qualifier	RL
Monochlorobiphenyl	0.094	U	0.094
Dichlorobiphenyl	0.094	U	0.094
Trichlorobiphenyl	0.094	U	0.094
Tetrachlorobiphenyl	0.19	U	0.19
Pentachlorobiphenyl	0.19	U	0.19
Hexachlorobiphenyl	0.19	U	0.19
Heptachlorobiphenyl	0.28	U	0.28
Octachlorobiphenyl	0.28	U	0.28
Nonachlorobiphenyl	0.47	U	0.47
DCB Decachlorobiphenyl	0.47	U	0.47
Surrogate	%Rec		Acceptance Limits
Decachlorobiphenyl-13C12	80		44 - 104

**Analytical Data**

Client: Solutia Inc.

Job Number: 680-18095-1

Sdg Number: KPM001

Client Sample ID: PMA3S-0606-F

Lab Sample ID: 680-18095-18

Client Matrix: Water

Date Sampled: 06/29/2006 1200

Date Received: 07/01/2006 0900

**680 Polychlorinated Biphenyls by GCMS**

Method: 680  
Preparation: 680\_P\_Liquid  
Dilution: 1.0  
Date Analyzed: 07/14/2006 1651  
Date Prepared: 07/05/2006 1400

Analysis Batch: 680-50316  
Prep Batch: 680-49167

Instrument ID: GC/MS SemiVolatiles - F  
Lab File ID: N/A  
Initial Weight/Volume: 1060 mL  
Final Weight/Volume: 1 mL  
Injection Volume:

Analyte	Result (ug/L)	Qualifier	RL
Monochlorobiphenyl	0.094	U	0.094
Dichlorobiphenyl	0.094	U	0.094
Trichlorobiphenyl	0.094	U	0.094
Tetrachlorobiphenyl	0.19	U	0.19
Pentachlorobiphenyl	0.19	U	0.19
Hexachlorobiphenyl	0.19	U	0.19
Heptachlorobiphenyl	0.28	U	0.28
Octachlorobiphenyl	0.28	U	0.28
Nonachlorobiphenyl	0.47	U	0.47
DCB Decachlorobiphenyl	0.47	U	0.47
Surrogate	%Rec		Acceptance Limits
Decachlorobiphenyl-13C12	68		44 - 104

## Analytical Data

Client: Solutia Inc.

Job Number: 680-18095-1

Sdg Number: KPM001

Client Sample ID: PMA3M-0606-EB-F

Lab Sample ID: 680-18095-19

Client Matrix: Water

Date Sampled: 06/29/2006 1430

Date Received: 07/01/2006 0900

### 680 Polychlorinated Biphenyls by GCMS

Method: 680

Analysis Batch: 680-50316

Instrument ID: GC/MS SemiVolatiles - F

Preparation: 680\_P\_Liquid

Prep Batch: 680-49167

Lab File ID: N/A

Dilution: 1.0

Initial Weight/Volume: 1060 mL

Date Analyzed: 07/14/2006 1725

Final Weight/Volume: 1 mL

Date Prepared: 07/05/2006 1400

Injection Volume:

Analyte	Result (ug/L)	Qualifier	RL
Monochlorobiphenyl	0.094	U	0.094
Dichlorobiphenyl	0.094	U	0.094
Trichlorobiphenyl	0.094	U	0.094
Tetrachlorobiphenyl	0.19	U	0.19
Pentachlorobiphenyl	0.19	U	0.19
Hexachlorobiphenyl	0.19	U	0.19
Heptachlorobiphenyl	0.28	U	0.28
Octachlorobiphenyl	0.28	U	0.28
Nonachlorobiphenyl	0.47	U	0.47
DCB Decachlorobiphenyl	0.47	U	0.47
Surrogate	%Rec		Acceptance Limits
Decachlorobiphenyl-13C12	76		44 - 104

**Analytical Data**

Client: Solutia Inc.

Job Number: 680-18095-1

Sdg Number: KPM001

Client Sample ID: PMA3M-0606-F

Lab Sample ID: 680-18095-20

Date Sampled: 06/29/2006 1605

Client Matrix: Water

Date Received: 07/01/2006 0900

**680 Polychlorinated Biphenyls by GCMS**

Method: 680  
Preparation: 680\_P\_Liquid  
Dilution: 1.0  
Date Analyzed: 07/17/2006 1426  
Date Prepared: 07/05/2006 1400

Analysis Batch: 680-50316  
Prep Batch: 680-49167

Instrument ID: GC/MS SemiVolatiles - F  
Lab File ID: N/A  
Initial Weight/Volume: 1060 mL  
Final Weight/Volume: 1 mL  
Injection Volume:

Analyte	Result (ug/L)	Qualifier	RL
Monochlorobiphenyl	0.094	U	0.094
Dichlorobiphenyl	0.094	U	0.094
Trichlorobiphenyl	0.094	U	0.094
Tetrachlorobiphenyl	0.19	U	0.19
Pentachlorobiphenyl	0.19	U	0.19
Hexachlorobiphenyl	0.19	U	0.19
Heptachlorobiphenyl	0.28	U	0.28
Octachlorobiphenyl	0.28	U	0.28
Nonachlorobiphenyl	0.47	U	0.47
DCB Decachlorobiphenyl	0.47	U	0.47
Surrogate	%Rec		Acceptance Limits
Decachlorobiphenyl-13C12	66		44 - 104



## Analytical Data

Client: Solutia Inc.

Job Number: 680-18095-1

Sdg Number: KPM001

Client Sample ID: PMA1M-0606-F

Lab Sample ID: 680-18095-21

Client Matrix: Water

Date Sampled: 06/29/2006 1145

Date Received: 07/01/2006 0900

### 680 Polychlorinated Biphenyls by GCMS

Method: 680

Analysis Batch: 680-50316

Instrument ID: GC/MS SemiVolatiles - F

Preparation: 680\_P\_Liquid

Prep Batch: 680-49167

Lab File ID: N/A

Dilution: 1.0

Initial Weight/Volume: 1060 mL

Date Analyzed: 07/17/2006 1501

Final Weight/Volume: 1 mL

Date Prepared: 07/05/2006 1400

Injection Volume:

Analyte	Result (ug/L)	Qualifier	RL
Monochlorobiphenyl	0.094	U	0.094
Dichlorobiphenyl	0.094	U	0.094
Trichlorobiphenyl	0.094	U	0.094
Tetrachlorobiphenyl	0.19	U	0.19
Pentachlorobiphenyl	0.19	U	0.19
Hexachlorobiphenyl	0.19	U	0.19
Heptachlorobiphenyl	0.28	U	0.28
Octachlorobiphenyl	0.28	U	0.28
Nonachlorobiphenyl	0.47	U	0.47
DCB Decachlorobiphenyl	0.47	U	0.47
Surrogate	%Rec		Acceptance Limits
Decachlorobiphenyl-13C12	57		44 - 104

**Analytical Data**

Client: Solutia Inc.

Job Number: 680-18095-1

Sdg Number: KPM001

Client Sample ID: PMA1S-0606-F

Lab Sample ID: 680-18095-24

Date Sampled: 06/29/2006 1430

Client Matrix: Water

Date Received: 07/01/2006 0900

**680 Polychlorinated Biphenyls by GCMS**

Method: 680

Analysis Batch: 680-50316

Instrument ID: GC/MS SemiVolatiles - F

Preparation: 680\_P\_Liquid

Prep Batch: 680-49167

Lab File ID: N/A

Dilution: 1.0

Initial Weight/Volume: 1060 mL

Date Analyzed: 07/17/2006 1536

Final Weight/Volume: 1 mL

Date Prepared: 07/05/2006 1400

Injection Volume:

Analyte	Result (ug/L)	Qualifier	RL
Monochlorobiphenyl	0.094	U	0.094
Dichlorobiphenyl	0.094	U	0.094
Trichlorobiphenyl	0.094	U	0.094
Tetrachlorobiphenyl	0.19	U	0.19
Pentachlorobiphenyl	0.19	U	0.19
Hexachlorobiphenyl	0.19	U	0.19
Heptachlorobiphenyl	0.28	U	0.28
Octachlorobiphenyl	0.28	U	0.28
Nonachlorobiphenyl	0.47	U	0.47
DCB Decachlorobiphenyl	0.47	U	0.47

Surrogate

%Rec

Acceptance Limits

Decachlorobiphenyl-13C12

74

44 - 104

**Analytical Data**

Client: Solutia Inc.

Job Number: 680-18095-1

Sdg Number: KPM001

Client Sample ID: PMA-2M-0606-F

Lab Sample ID: 680-18095-25

Client Matrix: Water

Date Sampled: 06/29/2006 1700

Date Received: 07/01/2006 0900

**680 Polychlorinated Biphenyls by GCMS**

Method: 680

Analysis Batch: 680-50316

Instrument ID: GC/MS SemiVolatiles - F

Preparation: 680\_P\_Liquid

Prep Batch: 680-49167

Lab File ID: N/A

Dilution: 1.0

Initial Weight/Volume: 1060 mL

Date Analyzed: 07/17/2006 1610

Final Weight/Volume: 1 mL

Date Prepared: 07/05/2006 1400

Injection Volume:

Analyte	Result (ug/L)	Qualifier	RL
Monochlorobiphenyl	0.094	U	0.094
Dichlorobiphenyl	0.094	U	0.094
Trichlorobiphenyl	0.094	U	0.094
Tetrachlorobiphenyl	0.19	U	0.19
Pentachlorobiphenyl	0.19	U	0.19
Hexachlorobiphenyl	0.19	U	0.19
Heptachlorobiphenyl	0.28	U	0.28
Octachlorobiphenyl	0.28	U	0.28
Nonachlorobiphenyl	0.47	U	0.47
DCB Decachlorobiphenyl	0.47	U	0.47
Surrogate	%Rec		Acceptance Limits
Decachlorobiphenyl-13C12	64		44 - 104

**Analytical Data**

Client: Solutia Inc.

Job Number: 680-18095-1

Sdg Number: KPM001

Client Sample ID: PMA-2M-0606-AD-F

Lab Sample ID: 680-18095-26

Date Sampled: 06/29/2006 1700

Client Matrix: Water

Date Received: 07/01/2006 0900

**680 Polychlorinated Biphenyls by GCMS**

Method:	680	Analysis Batch:	680-50316	Instrument ID:	GC/MS SemiVolatiles - F
Preparation:	680_P_Liquid	Prep Batch:	680-49167	Lab File ID:	N/A
Dilution:	1.0			Initial Weight/Volume:	1060 mL
Date Analyzed:	07/17/2006 1645			Final Weight/Volume:	1 mL
Date Prepared:	07/05/2006 1400			Injection Volume:	

Analyte	Result (ug/L)	Qualifier	RL
Monochlorobiphenyl	0.094	U	0.094
Dichlorobiphenyl	0.094	U	0.094
Trichlorobiphenyl	0.094	U	0.094
Tetrachlorobiphenyl	0.19	U	0.19
Pentachlorobiphenyl	0.19	U	0.19
Hexachlorobiphenyl	0.19	U	0.19
Heptachlorobiphenyl	0.28	U	0.28
Octachlorobiphenyl	0.28	U	0.28
Nonachlorobiphenyl	0.47	U	0.47
DCB Decachlorobiphenyl	0.47	U	0.47
Surrogate	%Rec		Acceptance Limits
Decachlorobiphenyl-13C12	68		44 - 104

**Analytical Data**

Client: Solutia Inc.

Job Number: 680-18095-1

Sdg Number: KPM001

Client Sample ID: PMA2S-0606-F

Lab Sample ID: 680-18095-27

Client Matrix: Water

Date Sampled: 06/30/2006 0845

Date Received: 07/01/2006 0900

**680 Polychlorinated Biphenyls by GCMS**

Method: 680  
Preparation: 680\_P\_Liquid  
Dilution: 1.0  
Date Analyzed: 07/17/2006 1719  
Date Prepared: 07/05/2006 1400

Analysis Batch: 680-50316  
Prep Batch: 680-49167

Instrument ID: GC/MS SemiVolatiles - F  
Lab File ID: N/A  
Initial Weight/Volume: 1060 mL  
Final Weight/Volume: 1 mL  
Injection Volume:

Analyte	Result (ug/L)	Qualifier	RL
Monochlorobiphenyl	0.094	U	0.094
Dichlorobiphenyl	0.094	U	0.094
Trichlorobiphenyl	0.094	U	0.094
Tetrachlorobiphenyl	0.19	U	0.19
Pentachlorobiphenyl	0.19	U	0.19
Hexachlorobiphenyl	0.19	U	0.19
Heptachlorobiphenyl	0.28	U	0.28
Octachlorobiphenyl	0.28	U	0.28
Nonachlorobiphenyl	0.47	U	0.47
DCB Decachlorobiphenyl	0.47	U	0.47
Surrogate	%Rec		Acceptance Limits
Decachlorobiphenyl-13C12	81		44 - 104



# Analytical Data

Client: Solutia Inc.

Job Number: 680-18095-1

Sdg Number: KPM001

Client Sample ID: PMA3S-0606

Lab Sample ID: 680-18095-1

Date Sampled: 06/29/2006 1200

Client Matrix: Water

Date Received: 07/01/2006 0900

## 8270C Semivolatile Compounds by Gas Chromatography/Mass Spectrometry (GC/MS)

Method: 8270C

Analysis Batch: 680-50150

Instrument ID: GC/MS SemiVolatiles - G

Preparation: 3520C

Prep Batch: 680-49247

Lab File ID: g4941.d

Dilution: 1.0

Initial Weight/Volume: 1040 mL

Date Analyzed: 07/17/2006 1256

Final Weight/Volume: 1 mL

Date Prepared: 07/06/2006 1004

Injection Volume:

Analyte	Result (ug/L)	Qualifier	RL
Acenaphthene	9.6	U	9.6
Acenaphthylene	9.6	U	9.6
Acetophenone	9.6	U	9.6
2-Acetylaminofluorene	9.6	U	9.6
alpha,alpha-Dimethyl phenethylamine	1900	U	1900
4-Aminobiphenyl	9.6	U	9.6
Aniline	19	U	19
Anthracene	9.6	U	9.6
Aramite, Total	9.6	U	9.6
Benzo[a]anthracene	9.6	U	9.6
Benzo[a]pyrene	9.6	U	9.6
Benzo[b]fluoranthene	9.6	U	9.6
Benzo[g,h,i]perylene	9.6	U	9.6
Benzo[k]fluoranthene	9.6	U	9.6
Benzyl alcohol	9.6	U	9.6
1,1'-Biphenyl	9.6	U	9.6
Bis(2-chloroethoxy)methane	9.6	U	9.6
Bis(2-chloroethyl)ether	9.6	U	9.6
bis(chloroisopropyl) ether	9.6	U	9.6
Bis(2-ethylhexyl) phthalate	9.6	U	9.6
4-Bromophenyl phenyl ether	9.6	U	9.6
Butyl benzyl phthalate	9.6	U	9.6
4-Chloroaniline	19	U	19
4-Chloro-3-methylphenol	9.6	U	9.6
2-Chloronaphthalene	9.6	U	9.6
2-Chlorophenol	9.6	U	9.6
4-Chlorophenyl phenyl ether	9.6	U	9.6
Chrysene	9.6	U	9.6
Diallyl	9.6	U	9.6
Dibenz(a,h)anthracene	9.6	U	9.6
Dibenzofuran	9.6	U	9.6
3,3'-Dichlorobenzidine	19	U	19
2,4-Dichlorophenol	9.6	U	9.6
2,6-Dichlorophenol	9.6	U	9.6
Diethyl phthalate	9.6	U	9.6
Dimethoate	9.6	U	9.6
7,12-Dimethylbenz(a)anthracene	9.6	U	9.6
3,3'-Dimethylbenzidine	19	U	19
2,4-Dimethylphenol	9.6	U	9.6
Dimethyl phthalate	9.6	U	9.6
Di-n-butyl phthalate	9.6	U	9.6
1,3-Dinitrobenzene	9.6	U	9.6
4,6-Dinitro-2-methylphenol	48	U	48

**Analytical Data**

Client: Solutia Inc.

Job Number: 680-18095-1

Sdg Number: KPM001

Client Sample ID: PMA3S-0606

Lab Sample ID: 680-18095-1

Date Sampled: 06/29/2006 1200

Client Matrix: Water

Date Received: 07/01/2006 0900

**8270C Semivolatile Compounds by Gas Chromatography/Mass Spectrometry (GC/MS)**

Method:	8270C	Analysis Batch:	680-50150	Instrument ID:	GC/MS SemiVolatiles - G
Preparation:	3520C	Prep Batch:	680-49247	Lab File ID:	g4941.d
Dilution:	1.0			Initial Weight/Volume:	1040 mL
Date Analyzed:	07/17/2006 1256			Final Weight/Volume:	1 mL
Date Prepared:	07/06/2006 1004			Injection Volume:	

Analyte	Result (ug/L)	Qualifier	RL
2,4-Dinitrophenol	48	U	48
2,6-Dinitrotoluene	9.6	U	9.6
2,4-Dinitrotoluene	9.6	U	9.6
Di-n-octyl phthalate	9.6	U	9.6
Dinoseb	9.6	U	9.6
1,4-Dioxane	9.6	U	9.6
Disulfoton	9.6	U	9.6
Ethyl methanesulfonate	9.6	U	9.6
Famphur	9.6	U	9.6
Fluoranthene	9.6	U	9.6
Fluorene	9.6	U	9.6
Hexachlorobenzene	9.6	U	9.6
Hexachlorobutadiene	9.6	U	9.6
Hexachlorocyclopentadiene	9.6	U	9.6
Hexachloroethane	9.6	U	9.6
Hexachlorophene	4800	U	4800
Hexachloropropene	9.6	U	9.6
Indeno[1,2,3-cd]pyrene	9.6	U	9.6
Isophorone	9.6	U	9.6
Isosafrole	9.6	U	9.6
Methapyriline	1900	U	1900
3-Methylcholanthrene	9.6	U	9.6
Methyl methanesulfonate	9.6	U	9.6
2-Methylnaphthalene	9.6	U	9.6
Methyl parathion	9.6	U	9.6
2-Methylphenol	9.6	U	9.6
3 & 4 Methylphenol	9.6	U	9.6
Naphthalene	9.6	U	9.6
1,4-Naphthoquinone	9.6	U	9.6
1-Naphthylamine	9.6	U	9.6
2-Naphthylamine	9.6	U	9.6
3-Nitroaniline	48	U	48
2-Nitroaniline	48	U	48
4-Nitroaniline	48	U	48
Nitrobenzene	9.6	U	9.6
4-Nitrophenol	48	U	48
2-Nitrophenol	9.6	U	9.6
4-Nitroquinoline-1-oxide	19	U	19
N-Nitro-o-toluidine	9.6	U	9.6
N-Nitrosodiethylamine	9.6	U	9.6
N-Nitrosodimethylamine	9.6	U	9.6
N-Nitrosodi-n-butylamine	9.6	U	9.6
N-Nitrosodi-n-propylamine	9.6	U	9.6

# Analytical Data

Client: Solutia Inc.

Job Number: 680-18095-1

Sdg Number: KPM001

Client Sample ID: PMA3S-0606

Lab Sample ID: 680-18095-1

Date Sampled: 06/29/2006 1200

Client Matrix: Water

Date Received: 07/01/2006 0900

## 8270C Semivolatile Compounds by Gas Chromatography/Mass Spectrometry (GC/MS)

Method:	8270C	Analysis Batch:	680-50150	Instrument ID:	GC/MS SemiVolatiles - G
Preparation:	3520C	Prep Batch:	680-49247	Lab File ID:	g4941.d
Dilution:	1.0			Initial Weight/Volume:	1040 mL
Date Analyzed:	07/17/2006 1256			Final Weight/Volume:	1 mL
Date Prepared:	07/06/2006 1004			Injection Volume:	

Analyte	Result (ug/L)	Qualifier	RL
N-Nitrosodiphenylamine	9.6	U	9.6
n-Nitrosomethylethylamine	9.6	U	9.6
N-Nitrosomorpholine	9.6	U	9.6
N-Nitrosopiperidine	9.6	U	9.6
N-Nitrosopyrrolidine	9.6	U	9.6
o,o',o"-Triethylphosphorothioate	9.6	U	9.6
Parathion	9.6	U	9.6
p-Dimethylamino azobenzene	9.6	U	9.6
Pentachlorobenzene	9.6	U	9.6
Pentachloronitrobenzene	9.6	U	9.6
Pentachlorophenol	48	U	48
Phenacetin	9.6	U	9.6
Phenanthrene	9.6	U	9.6
Phenol	9.6	U	9.6
Phorate	9.6	U	9.6
2-Picoline	9.6	U	9.6
p-Phenylene diamine	1900	U	1900
Pronamide	9.6	U	9.6
Pyrene	9.6	U	9.6
Pyridine	48	U	48
Safrole, Total	9.6	U	9.6
Sulfotepp	9.6	U	9.6
1,2,4,5-Tetrachlorobenzene	9.6	U	9.6
2,3,4,6-Tetrachlorophenol	9.6	U	9.6
Thionazin	9.6	U	9.6
2-Toluidine	9.6	U	9.6
1,2,4-Trichlorobenzene	9.6	U	9.6
2,4,5-Trichlorophenol	9.6	U	9.6
2,4,6-Trichlorophenol	9.6	U	9.6
1,3,5-Trinitrobenzene	9.6	U	9.6
1-Chloro-3-nitrobenzene	9.6	U	9.6
1-Chloro-4-nitrobenzene	9.6	U	9.6
1-Chloro-2-nitrobenzene	9.6	U	9.6
2-Nitrobiphenyl	9.6	U	9.6
2,4-Dichloronitrobenzene	9.6	U	9.6
3-Nitrobiphenyl	9.6	U	9.6
3,4-Dichloronitrobenzene	9.6	U	9.6
4-Nitrobiphenyl	9.6	U	9.6

Surrogate	%Rec	Acceptance Limits
2-Fluorobiphenyl	88	59 - 103
2-Fluorophenol	77	56 - 100
Nitrobenzene-d5	86	60 - 102
Phenol-d5	87	55 - 104

**Analytical Data**

Client: Solutia Inc.

Job Number: 680-18095-1

Sdg Number: KPM001

Client Sample ID: PMA3S-0606

Lab Sample ID: 680-18095-1

Client Matrix: Water

Date Sampled: 06/29/2006 1200

Date Received: 07/01/2006 0900

**8270C Semivolatile Compounds by Gas Chromatography/Mass Spectrometry (GC/MS)**

Method:	8270C	Analysis Batch:	680-50150	Instrument ID:	GC/MS SemiVolatiles - G
Preparation:	3520C	Prep Batch:	680-49247	Lab File ID:	g4941.d
Dilution:	1:0			Initial Weight/Volume:	1040 mL
Date Analyzed:	07/17/2006 1256			Final Weight/Volume:	1 mL
Date Prepared:	07/06/2006 1004			Injection Volume:	

Surrogate	%Rec	Acceptance Limits
Terphenyl-d14	100	10 - 154
2,4,6-Tribromophenol	102	55 - 126

# Analytical Data

Client: Solutia Inc.

Job Number: 680-18095-1

Sdg Number: KPM001

Client Sample ID: PMA3M-0606-EB

Lab Sample ID: 680-18095-2EB

Date Sampled: 06/29/2006 1430

Client Matrix: Water

Date Received: 07/01/2006 0900

## 8270C Semivolatile Compounds by Gas Chromatography/Mass Spectrometry (GC/MS)

Method:	8270C	Analysis Batch:	680-50150	Instrument ID:	GC/MS SemiVolatiles - G
Preparation:	3520C	Prep Batch:	680-49247	Lab File ID:	g4943.d
Dilution:	1.0			Initial Weight/Volume:	1040 mL
Date Analyzed:	07/17/2006 1347			Final Weight/Volume:	1 mL
Date Prepared:	07/06/2006 1004			Injection Volume:	

Analyte	Result:(ug/L)	Qualifier	RL
Acenaphthene	9.6	U	9.6
Acenaphthylene	9.6	U	9.6
Acetophenone	9.6	U	9.6
2-Acetylaminofluorene	9.6	U	9.6
alpha,alpha-Dimethyl phenethylamine	1900	U	1900
4-Aminobiphenyl	9.6	U	9.6
Aniline	19	U	19
Anthracene	9.6	U	9.6
Aramite, Total	9.6	U	9.6
Benzo[a]anthracene	9.6	U	9.6
Benzo[a]pyrene	9.6	U	9.6
Benzo[b]fluoranthene	9.6	U	9.6
Benzo[g,h,i]perylene	9.6	U	9.6
Benzo[k]fluoranthene	9.6	U	9.6
Benzyl alcohol	9.6	U	9.6
1,1'-Biphenyl	9.6	U	9.6
Bis(2-chloroethoxy)methane	9.6	U	9.6
Bis(2-chloroethyl)ether	9.6	U	9.6
bis(chloroisopropyl) ether	9.6	U	9.6
Bis(2-ethylhexyl) phthalate	9.6	U	9.6
4-Bromophenyl phenyl ether	9.6	U	9.6
Butyl benzyl phthalate	9.6	U	9.6
4-Chloroaniline	19	U	19
4-Chloro-3-methylphenol	9.6	U	9.6
2-Chloronaphthalene	9.6	U	9.6
2-Chlorophenol	9.6	U	9.6
4-Chlorophenyl phenyl ether	9.6	U	9.6
Chrysene	9.6	U	9.6
Diallate	9.6	U	9.6
Dibenz(a,h)anthracene	9.6	U	9.6
Dibenzofuran	9.6	U	9.6
3,3'-Dichlorobenzidine	19	U	19
2,4-Dichlorophenol	9.6	U	9.6
2,6-Dichlorophenol	9.6	U	9.6
Diethyl phthalate	9.6	U	9.6
Dimethoate	9.6	U	9.6
7,12-Dimethylbenz(a)anthracene	9.6	U	9.6
3,3'-Dimethylbenzidine	19	U	19
2,4-Dimethylphenol	9.6	U	9.6
Dimethyl phthalate	9.6	U	9.6
Di-n-butyl phthalate	9.6	U	9.6
1,3-Dinitrobenzene	9.6	U	9.6
4,6-Dinitro-2-methylphenol	48	U	48



**Analytical Data**

Client: Solutia Inc.

Job Number: 680-18095-1

Sdg Number: KPM001

Client Sample ID: PMA3M-0606-EB

Lab Sample ID: 680-18095-2EB

Date Sampled: 06/29/2006 1430

Client Matrix: Water

Date Received: 07/01/2006 0900

**8270C Semivolatile Compounds by Gas Chromatography/Mass Spectrometry (GC/MS)**

Method:	8270C	Analysis Batch:	680-50150	Instrument ID:	GC/MS SemiVolatiles - G
Preparation:	3520C	Prep Batch:	680-49247	Lab File ID:	g4943.d
Dilution:	1.0			Initial Weight/Volume:	1040 mL
Date Analyzed:	07/17/2006 1347			Final Weight/Volume:	1 mL
Date Prepared:	07/06/2006 1004			Injection Volume:	

Analyte	Result (ug/L)	Qualifier	RL
2,4-Dinitrophenol	48	U	48
2,6-Dinitrotoluene	9.6	U	9.6
2,4-Dinitrotoluene	9.6	U	9.6
Di-n-octyl phthalate	9.6	U	9.6
Dinoseb	9.6	U	9.6
1,4-Dioxane	9.6	U	9.6
Disulfoton	9.6	U	9.6
Ethyl methanesulfonate	9.6	U	9.6
Famphur	9.6	U	9.6
Fluoranthene	9.6	U	9.6
Fluorene	9.6	U	9.6
Hexachlorobenzene	9.6	U	9.6
Hexachlorobutadiene	9.6	U	9.6
Hexachlorocyclopentadiene	9.6	U	9.6
Hexachloroethane	9.6	U	9.6
Hexachlorophene	4800	U	4800
Hexachloropropene	9.6	U	9.6
Indeno[1,2,3-cd]pyrene	9.6	U	9.6
Isophorone	9.6	U	9.6
Isosafrole	9.6	U	9.6
Methapyrilene	1900	U	1900
3-Methylcholanthrene	9.6	U	9.6
Methyl methanesulfonate	9.6	U	9.6
2-Methylnaphthalene	9.6	U	9.6
Methyl parathion	9.6	U	9.6
2-Methylphenol	9.6	U	9.6
3 & 4 Methylphenol	9.6	U	9.6
Naphthalene	9.6	U	9.6
1,4-Naphthoquinone	9.6	U	9.6
1-Naphthylamine	9.6	U	9.6
2-Naphthylamine	9.6	U	9.6
3-Nitroaniline	48	U	48
2-Nitroaniline	48	U	48
4-Nitroaniline	48	U	48
Nitrobenzene	9.6	U	9.6
4-Nitrophenol	48	U	48
2-Nitrophenol	9.6	U	9.6
4-Nitroquinoline-1-oxide	19	U	19
N-Nitro-o-toluidine	9.6	U	9.6
N-Nitrosodiethylamine	9.6	U	9.6
N-Nitrosodimethylamine	9.6	U	9.6
N-Nitrosodi-n-butylamine	9.6	U	9.6
N-Nitrosodi-n-propylamine	9.6	U	9.6

# Analytical Data

Client: Solutia Inc.

Job Number: 680-18095-1

Sdg Number: KPM001

Client Sample ID: PMA3M-0606-EB

Lab Sample ID: 680-18095-2EB

Date Sampled: 06/29/2006 1430

Client Matrix: Water

Date Received: 07/01/2006 0900

## 8270C Semivolatile Compounds by Gas Chromatography/Mass Spectrometry (GC/MS)

Method: 8270C

Analysis Batch: 680-50150

Instrument ID: GC/MS SemiVolatiles - G

Preparation: 3520C

Prep Batch: 680-49247

Lab File ID: g4943.d

Dilution: 1.0

Initial Weight/Volume: 1040 mL

Date Analyzed: 07/17/2006 1347

Final Weight/Volume: 1 mL

Date Prepared: 07/06/2006 1004

Injection Volume:

Analyte	Result (ug/L)	Qualifier	RL
N-Nitrosodiphenylamine	9.6	U	9.6
n-Nitrosomethylethylamine	9.6	U	9.6
N-Nitrosomorpholine	9.6	U	9.6
N-Nitrosopiperidine	9.6	U	9.6
N-Nitrosopyrrolidine	9.6	U	9.6
o,o',o"-Triethylphosphorothioate	9.6	U	9.6
Parathion	9.6	U	9.6
p-Dimethylamino azobenzene	9.6	U	9.6
Pentachlorobenzene	9.6	U	9.6
Pentachloronitrobenzene	9.6	U	9.6
Pentachlorophenol	48	U	48
Phenacetin	9.6	U	9.6
Phenanthrene	9.6	U	9.6
Phenol	9.6	U	9.6
Phorate	9.6	U	9.6
2-Picoline	9.6	U	9.6
p-Phenylenediamine	1900	U	1900
Pronamide	9.6	U	9.6
Pyrene	9.6	U	9.6
Pyridine	48	U	48
Safrole, Total	9.6	U	9.6
Sulfotepp	9.6	U	9.6
1,2,4,5-Tetrachlorobenzene	9.6	U	9.6
2,3,4,6-Tetrachlorophenol	9.6	U	9.6
Thionazin	9.6	U	9.6
2-Toluidine	9.6	U	9.6
1,2,4-Trichlorobenzene	9.6	U	9.6
2,4,5-Trichlorophenol	9.6	U	9.6
2,4,6-Trichlorophenol	9.6	U	9.6
1,3,5-Trinitrobenzene	9.6	U	9.6
1-Chloro-3-nitrobenzene	9.6	U	9.6
1-Chloro-4-nitrobenzene	9.6	U	9.6
1-Chloro-2-nitrobenzene	9.6	U	9.6
2-Nitrobiphenyl	9.6	U	9.6
2,4-Dichloronitrobenzene	9.6	U	9.6
3-Nitrobiphenyl	9.6	U	9.6
3,4-Dichloronitrobenzene	9.6	U	9.6
4-Nitrobiphenyl	9.6	U	9.6
Surrogate	%Rec		Acceptance Limits
2-Fluorobiphenyl	92		59 - 103
2-Fluorophenol	80		56 - 100
Nitrobenzene-d5	82		60 - 102
Phenol-d5	86		55 - 104

## Analytical Data

Client: Solutia Inc.

Job Number: 680-18095-1

Sdg Number: KPM001

Client Sample ID: PMA3M-0606-EB

Lab Sample ID: 680-18095-2EB

Date Sampled: 06/29/2006 1430

Client Matrix: Water

Date Received: 07/01/2006 0900

### 8270C Semivolatile Compounds by Gas Chromatography/Mass Spectrometry (GC/MS)

Method: 8270C

Analysis Batch: 680-50150

Instrument ID: GC/MS SemiVolatiles - G

Preparation: 3520C

Prep Batch: 680-49247

Lab File ID: g4943.d

Dilution: 1.0

Initial Weight/Volume: 1040 mL

Date Analyzed: 07/17/2006 1347

Final Weight/Volume: 1 mL

Date Prepared: 07/06/2006 1004

Injection Volume:

Surrogate	%Rec	Acceptance Limits
Terphenyl-d14	115	10 - 154
2,4,6-Tribromophenol	99	55 - 126

**Analytical Data**

Client: Solutia Inc.

Job Number: 680-18095-1

Sdg Number: KPM001

Client Sample ID: PMA3M-0606

Lab Sample ID: 680-18095-3

Date Sampled: 06/29/2006 1605

Client Matrix: Water

Date Received: 07/01/2006 0900

**8270C Semivolatile Compounds by Gas Chromatography/Mass Spectrometry (GC/MS)**

Method: 8270C

Analysis Batch: 680-50286

Instrument ID: GC/MS SemiVolatiles - G

Preparation: 3520C

Prep Batch: 680-49247

Lab File ID: g4979.d

Dilution: 1.0

Initial Weight/Volume: 1060 mL

Date Analyzed: 07/18/2006 1858

Final Weight/Volume: 1 mL

Date Prepared: 07/06/2006 1004

Injection Volume:

Analyte	Result (ug/L)	Qualifier	RL
Acenaphthene	9.4	U	9.4
Acenaphthylene	9.4	U	9.4
Acetophenone	9.4	U	9.4
2-Acetylaminofluorene	9.4	U	9.4
alpha,alpha-Dimethyl phenethylamine	1900	U	1900
4-Aminobiphenyl	9.4	U	9.4
Aniline	19	U	19
Anthracene	9.4	U	9.4
Aramite, Total	9.4	U	9.4
Benzo[a]anthracene	9.4	U	9.4
Benzo[a]pyrene	9.4	U	9.4
Benzo[b]fluoranthene	9.4	U	9.4
Benzo[g,h,i]perylene	9.4	U	9.4
Benzo[k]fluoranthene	9.4	U	9.4
Benzyl alcohol	9.4	U	9.4
1,1'-Biphenyl	9.4	U	9.4
Bis(2-chloroethoxy)methane	9.4	U	9.4
Bis(2-chloroethyl)ether	9.4	U	9.4
bis(chloroisopropyl) ether	9.4	U	9.4
Bis(2-ethylhexyl) phthalate	9.4	U	9.4
4-Bromophenyl phenyl ether	9.4	U	9.4
Butyl benzyl phthalate	9.4	U	9.4
4-Chloroaniline	120		19
4-Chloro-3-methylphenol	9.4	U	9.4
2-Chloronaphthalene	9.4	U	9.4
2-Chlorophenol	9.4	U	9.4
4-Chlorophenyl phenyl ether	9.4	U	9.4
Chrysene	9.4	U	9.4
Diallate	9.4	U	9.4
Dibenz(a,h)anthracene	9.4	U	9.4
Dibenzofuran	9.4	U	9.4
3,3'-Dichlorobenzidine	19	U	19
2,6-Dichlorophenol	9.4	U	9.4
2,4-Dichlorophenol	9.4	U	9.4
Diethyl phthalate	9.4	U	9.4
Dimethoate	9.4	U	9.4
7,12-Dimethylbenz(a)anthracene	9.4	U	9.4
3,3'-Dimethylbenzidine	19	U	19
2,4-Dimethylphenol	40		9.4
Dimethyl phthalate	9.4	U	9.4
Di-n-butyl phthalate	9.4	U	9.4
1,3-Dinitrobenzene	9.4	U	9.4
4,6-Dinitro-2-methylphenol	47	U	47

**Analytical Data**

Client: Solutia Inc.

Job Number: 680-18095-1

Sdg Number: KPM001

Client Sample ID: PMA3M-0606

Lab Sample ID: 680-18095-3

Date Sampled: 06/29/2006 1605

Client Matrix: Water

Date Received: 07/01/2006 0900

**8270C Semivolatile Compounds by Gas Chromatography/Mass Spectrometry (GC/MS)**

Method:	8270C	Analysis Batch:	680-50286	Instrument ID:	GC/MS SemiVolatiles - G
Preparation:	3520C	Prep Batch:	680-49247	Lab File ID:	g4979.d
Dilution:	1.0			Initial Weight/Volume:	1060 mL
Date Analyzed:	07/18/2006 1858			Final Weight/Volume:	1 mL
Date Prepared:	07/06/2006 1004			Injection Volume:	

Analyte	Result (ug/L)	Qualifier	RL
2,4-Dinitrophenol	47	U	47
2,6-Dinitrotoluene	9.4	U	9.4
2,4-Dinitrotoluene	9.4	U	9.4
Di-n-octyl phthalate	9.4	U	9.4
Dinoseb	9.4	U	9.4
1,4-Dioxane	9.4	U	9.4
Disulfoton	9.4	U	9.4
Ethyl methanesulfonate	9.4	U	9.4
Famphur	9.4	U	9.4
Fluoranthene	9.4	U	9.4
Fluorene	9.4	U	9.4
Hexachlorobenzene	9.4	U	9.4
Hexachlorobutadiene	9.4	U	9.4
Hexachlorocyclopentadiene	9.4	U	9.4
Hexachloroethane	9.4	U	9.4
Hexachlorophene	4700	U	4700
Hexachloropropene	9.4	U	9.4
Indeno[1,2,3-cd]pyrene	9.4	U	9.4
Isophorone	9.4	U	9.4
Isosafrole	9.4	U	9.4
Methapyrilene	1900	U	1900
3-Methylcholanthrene	9.4	U	9.4
Methyl methanesulfonate	9.4	U	9.4
2-Methylnaphthalene	9.4	U	9.4
Methyl parathion	9.4	U	9.4
2-Methylphenol	9.4	U	9.4
3 & 4 Methylphenol	16		9.4
Naphthalene	29		9.4
1,4-Naphthoquinone	9.4	U	9.4
1-Naphthylamine	9.4	U	9.4
2-Naphthylamine	9.4	U	9.4
3-Nitroaniline	47	U	47
2-Nitroaniline	47	U	47
4-Nitroaniline	47	U	47
Nitrobenzene	9.4	U	9.4
4-Nitrophenol	47	U	47
2-Nitrophenol	9.4	U	9.4
4-Nitroquinoline-1-oxide	19	U	19
N-Nitro-o-toluidine	9.4	U	9.4
N-Nitrosodiethylamine	9.4	U	9.4
N-Nitrosodimethylamine	9.4	U	9.4
N-Nitrosodi-n-butylamine	9.4	U	9.4
N-Nitrosodi-n-propylamine	9.4	U	9.4



**Analytical Data**

Client: Solutia Inc.

Job Number: 680-18095-1

Sdg Number: KPM001

Client Sample ID: PMA3M-0606

Lab Sample ID: 680-18095-3

Client Matrix: Water

Date Sampled: 06/29/2006 1605

Date Received: 07/01/2006 0900

**8270C Semivolatile Compounds by Gas Chromatography/Mass Spectrometry (GC/MS)**

Method: 8270C

Analysis Batch: 680-50286

Instrument ID: GC/MS SemiVolatiles - G

Preparation: 3520C

Prep Batch: 680-49247

Lab File ID: g4979.d

Dilution: 1.0

Initial Weight/Volume: 1060 mL

Date Analyzed: 07/18/2006 1858

Final Weight/Volume: 1 mL

Date Prepared: 07/06/2006 1004

Injection Volume:

Analyte	Result (ug/L)	Qualifier	RL
N-Nitrosodiphenylamine	9.4	U	9.4
n-Nitrosomethylethylamine	9.4	U	9.4
N-Nitrosomorpholine	9.4	U	9.4
N-Nitrosopiperidine	9.4	U	9.4
N-Nitrosopyrrolidine	9.4	U	9.4
o,o',o"-Triethylphosphorothioate	9.4	U	9.4
Parathion	9.4	U	9.4
p-Dimethylamino azobenzene	9.4	U	9.4
Pentachlorobenzene	9.4	U	9.4
Pentachloronitrobenzene	9.4	U	9.4
Pentachlorophenol	47	U	47
Phenacetin	9.4	U	9.4
Phenanthrene	9.4	U	9.4
Phenol	9.4	U	9.4
Phorate	9.4	U	9.4
2-Picoline	9.4	U	9.4
p-Phenylene diamine	1900	U	1900
Pronamide	9.4	U	9.4
Pyrene	9.4	U	9.4
Pyridine	47	U	47
Safrole, Total	9.4	U	9.4
Sulfotepp	9.4	U	9.4
1,2,4,5-Tetrachlorobenzene	9.4	U	9.4
2,3,4,6-Tetrachlorophenol	9.4	U	9.4
Thionazin	9.4	U	9.4
2-Toluidine	9.4	U	9.4
1,2,4-Trichlorobenzene	9.4	U	9.4
2,4,6-Trichlorophenol	9.4	U	9.4
2,4,5-Trichlorophenol	9.4	U	9.4
1,3,5-Trinitrobenzene	9.4	U	9.4
1-Chloro-3-nitrobenzene	9.4	U	9.4
1-Chloro-4-nitrobenzene	9.4	U	9.4
1-Chloro-2-nitrobenzene	9.4	U	9.4
2-Nitrobiphenyl	9.4	U	9.4
2,4-Dichloronitrobenzene	9.4	U	9.4
3-Nitrobiphenyl	9.4	U	9.4
3,4-Dichloronitrobenzene	9.4	U	9.4
4-Nitrobiphenyl	9.4	U	9.4
Surrogate	%Rec		Acceptance Limits
2-Fluorobiphenyl	88		59 - 103
2-Fluorophenol	81		56 - 100
Nitrobenzene-d5	82		60 - 102
Phenol-d5	87		55 - 104

**Analytical Data**

Client: Solutia Inc.

Job Number: 680-18095-1

Sdg Number: KPM001

Client Sample ID: PMA3M-0606

Lab Sample ID: 680-18095-3

Client Matrix: Water

Date Sampled: 06/29/2006 1605

Date Received: 07/01/2006 0900

**8270C Semivolatile Compounds by Gas Chromatography/Mass Spectrometry (GC/MS)**

Method: 8270C

Analysis Batch: 680-50286

Instrument ID: GC/MS SemiVolatiles - G

Preparation: 3520C

Prep Batch: 680-49247

Lab File ID: g4979.d

Dilution: 1.0

Initial Weight/Volume: 1060 mL

Date Analyzed: 07/18/2006 1858

Final Weight/Volume: 1 mL

Date Prepared: 07/06/2006 1004

Injection Volume:

Surrogate

%Rec

Acceptance Limits

Terphenyl-d14

32

10 - 154

2,4,6-Tribromophenol

103

55 - 126

# Analytical Data

Client: Solutia Inc.

Job Number: 680-18095-1

Sdg Number: KPM001

Client Sample ID: PMA1M-0606

Lab Sample ID: 680-18095-4

Client Matrix: Water

Date Sampled: 06/29/2006 1145

Date Received: 07/01/2006 0900

## 8270C Semivolatile Compounds by Gas Chromatography/Mass Spectrometry (GC/MS)

Method: 8270C

Analysis Batch: 680-50714

Instrument ID: GC/MS SemiVolatiles - G

Preparation: 3520C

Prep Batch: 680-49247

Lab File ID: g5058.d

Dilution: 1.0

Initial Weight/Volume: 1040 mL

Date Analyzed: 07/25/2006 1325

Final Weight/Volume: 1 mL

Date Prepared: 07/06/2006 1004

Injection Volume:

Analyte	Result (ug/L)	Qualifier	RL
Acenaphthene	9.6	U "uJ"	9.6
Acenaphthylene	9.6	U	9.6
Acetophenone	9.6	U	9.6
2-Acetylaminofluorene	9.6	U	9.6
alpha, alpha-Dimethyl phenethylamine	1900	U	1900
4-Aminobiphenyl	9.6	U	9.6
Aniline	19	U	19
Anthracene	9.6	U	9.6
Aramite, Total	9.6	U	9.6
Benzo[a]anthracene	9.6	U	9.6
Benzo[a]pyrene	9.6	U	9.6
Benzo[b]fluoranthene	9.6	U	9.6
Benzo[g,h,i]perylene	9.6	U	9.6
Benzo[k]fluoranthene	9.6	U	9.6
Benzyl alcohol	9.6	U	9.6
1,1'-Biphenyl	9.6	U	9.6
Bis(2-chloroethoxy)methane	9.6	U	9.6
Bis(2-chloroethyl)ether	9.6	U	9.6
bis(chloroisopropyl) ether	9.6	U	9.6
Bis(2-ethylhexyl) phthalate	9.6	U	9.6
4-Bromophenyl phenyl ether	9.6	U	9.6
Butyl benzyl phthalate	9.6	U "uJ"	9.6
4-Chloroaniline	70	"J"	19
4-Chloro-3-methylphenol	9.6	U "uJ"	9.6
2-Chloronaphthalene	9.6	U	9.6
2-Chlorophenol	9.6	U	9.6
4-Chlorophenyl phenyl ether	9.6	U	9.6
Chrysene	9.6	U	9.6
Diallate	9.6	U	9.6
Dibenz(a,h)anthracene	9.6	U	9.6
Dibenzofuran	9.6	U	9.6
3,3'-Dichlorobenzidine	19	U	19
2,4-Dichlorophenol	9.6	U	9.6
2,6-Dichlorophenol	9.6	U	9.6
Diethyl phthalate	9.6	U	9.6
Dimethoate	9.6	U	9.6
7,12-Dimethylbenz(a)anthracene	9.6	U	9.6
3,3'-Dimethylbenzidine	19	U	19
2,4-Dimethylphenol	9.6	U	9.6
Dimethyl phthalate	9.6	U	9.6
Di-n-butyl phthalate	9.6	U	9.6
1,3-Dinitrobenzene	9.6	U	9.6
4,6-Dinitro-2-methylphenol	48	U "uJ"	48

**Analytical Data**

Client: Solutia Inc.

Job Number: 680-18095-1

Sdg Number: KPM001

Client Sample ID: PMA1M-0606

Lab Sample ID: 680-18095-4

Client Matrix: Water

Date Sampled: 06/29/2006 1145

Date Received: 07/01/2006 0900

**8270C Semivolatile Compounds by Gas Chromatography/Mass Spectrometry (GC/MS)**

Method: 8270C  
Preparation: 3520C  
Dilution: 1.0  
Date Analyzed: 07/25/2006 1325  
Date Prepared: 07/06/2006 1004

Analysis Batch: 680-50714  
Prep Batch: 680-49247

Instrument ID: GC/MS SemiVolatiles - G  
Lab File ID: g5058.d  
Initial Weight/Volume: 1040 mL  
Final Weight/Volume: 1 mL  
Injection Volume:

Analyte	Result (ug/L)	Qualifier	RL
2,4-Dinitrophenol	48	U "uJ"	48
2,6-Dinitrotoluene	9.6	U	9.6
2,4-Dinitrotoluene	9.6	U	9.6
Di-n-octyl phthalate	9.6	U	9.6
Dinoseb	9.6	U	9.6
1,4-Dioxane	9.6	U	9.6
Disulfoton	9.6	U	9.6
Ethyl methanesulfonate	9.6	U	9.6
Famphur	9.6	U	9.6
Fluoranthene	9.6	U	9.6
Fluorene	9.6	U	9.6
Hexachlorobenzene	9.6	U	9.6
Hexachlorobutadiene	9.6	U	9.6
Hexachlorocyclopentadiene	9.6	U	9.6
Hexachloroethane	9.6	U	9.6
Hexachlorophene	4800	U	4800
Hexachloropropene	9.6	U	9.6
Indeno[1,2,3-cd]pyrene	9.6	U	9.6
Isophorone	9.6	U	9.6
Isosafrole	9.6	U	9.6
Methapyrilene	1900	U	1900
3-Methylcholanthrene	9.6	U	9.6
Methyl methanesulfonate	9.6	U	9.6
2-Methylnaphthalene	9.6	U	9.6
Methyl parathion	9.6	U	9.6
2-Methylphenol	9.6	U	9.6
3 & 4 Methylphenol	9.6	U	9.6
Naphthalene	9.6	U	9.6
1,4-Naphthoquinone	9.6	U	9.6
1-Naphthylamine	9.6	U	9.6
2-Naphthylamine	9.6	U	9.6
3-Nitroaniline	48	U	48
2-Nitroaniline	48	U	48
4-Nitroaniline	48	U	48
Nitrobenzene	9.6	U	9.6
4-Nitrophenol	48	U	48
2-Nitrophenol	9.6	U	9.6
4-Nitroquinoline-1-oxide	19	U	19
N-Nitro-o-toluidine	9.6	U	9.6
N-Nitrosodiethylamine	9.6	U	9.6
N-Nitrosodimethylamine	9.6	U	9.6
N-Nitrosodi-n-butylamine	9.6	U	9.6
N-Nitrosodi-n-propylamine	9.6	U "uJ"	9.6

# Analytical Data

Client: Solutia Inc.

Job Number: 680-18095-1

Sdg Number: KPM001

Client Sample ID: PMA1M-0606

Lab Sample ID: 680-18095-4

Date Sampled: 06/29/2006 1145

Client Matrix: Water

Date Received: 07/01/2006 0900

## 8270C Semivolatile Compounds by Gas Chromatography/Mass Spectrometry (GC/MS)

Method: 8270C

Analysis Batch: 680-50714

Instrument ID: GC/MS SemiVolatiles - G

Preparation: 3520C

Prep Batch: 680-49247

Lab File ID: g5058.d

Dilution: 1.0

Initial Weight/Volume: 1040 mL

Date Analyzed: 07/25/2006 1325

Final Weight/Volume: 1 mL

Date Prepared: 07/06/2006 1004

Injection Volume:

Analyte	Result (ug/L)	Qualifier	RL
N-Nitrosodiphenylamine	9.6	U "u3"	9.6
n-Nitrosomethylethylamine	9.6	U	9.6
N-Nitrosomorpholine	9.6	U	9.6
N-Nitrosopiperidine	9.6	U	9.6
N-Nitrosopyrrolidine	9.6	U	9.6
o,o',o"-Triethylphosphorothioate	9.6	U	9.6
Parathion	9.6	U	9.6
p-Dimethylamino azobenzene	9.6	U	9.6
Pentachlorobenzene	9.6	U	9.6
Pentachloronitrobenzene	9.6	U	9.6
Pentachlorophenol	48	U	48
Phenacetin	9.6	U	9.6
Phenanthrene	9.6	U "u3"	9.6
Phenol	39	U "u3"	9.6
Phorate	9.6	U "u3"	9.6
2-Picoline	9.6	U	9.6
p-Phenylene diamine	1900	U	1900
Pronamide	9.6	U	9.6
Pyrene	9.6	U	9.6
Pyridine	48	U	48
Safole, Total	9.6	U	9.6
Sulfotepp	9.6	U	9.6
1,2,4,5-Tetrachlorobenzene	9.6	U	9.6
2,3,4,6-Tetrachlorophenol	9.6	U	9.6
Thionazin	9.6	U	9.6
2-Toluidine	9.6	U	9.6
1,2,4-Trichlorobenzene	9.6	U	9.6
2,4,5-Trichlorophenol	9.6	U	9.6
2,4,6-Trichlorophenol	9.6	U	9.6
1,3,5-Trinitrobenzene	9.6	U	9.6
1-Chloro-3-nitrobenzene	9.6	U	9.6
1-Chloro-4-nitrobenzene	9.6	U	9.6
1-Chloro-2-nitrobenzene	9.6	U	9.6
2-Nitrobiphenyl	9.6	U	9.6
2,4-Dichloronitrobenzene	9.6	U	9.6
3-Nitrobiphenyl	9.6	U	9.6
3,4-Dichloronitrobenzene	9.6	U	9.6
4-Nitrobiphenyl	9.6	U "u3"	9.6

Surrogate	%Rec	Acceptance Limits
2-Fluorobiphenyl	79	59 - 103
2-Fluorophenol	73	56 - 100
Nitrobenzene-d5	69	60 - 102
Phenol-d5	80	55 - 104

**Analytical Data**

Client: Solutia Inc.

Job Number: 680-18095-1

Sdg Number: KPM001

Client Sample ID: PMA1M-0606

Lab Sample ID: 680-18095-4

Client Matrix: Water

Date Sampled: 06/29/2006 1145

Date Received: 07/01/2006 0900

**8270C Semivolatile Compounds by Gas Chromatography/Mass Spectrometry (GC/MS)**

Method: 8270C

Analysis Batch: 680-50714

Instrument ID: GC/MS SemiVolatiles - G

Preparation: 3520C

Prep Batch: 680-49247

Lab File ID: g5058.d

Dilution: 1.0

Initial Weight/Volume: 1040 mL

Date Analyzed: 07/25/2006 1325

Final Weight/Volume: 1 mL

Date Prepared: 07/06/2006 1004

Injection Volume:

Surrogate	%Rec	Acceptance Limits
Terphenyl-d14	82	10 - 154
2,4,6-Tribromophenol	103	55 - 126



# Analytical Data

Client: Solutia Inc.

Job Number: 680-18095-1

Sdg Number: KPM001

Client Sample ID: PMA1S-0606

Lab Sample ID: 680-18095-5

Client Matrix: Water

Date Sampled: 06/29/2006 1430

Date Received: 07/01/2006 0900

## 8270C Semivolatile Compounds by Gas Chromatography/Mass Spectrometry (GC/MS)

Method: 8270C

Analysis Batch: 680-50150

Instrument ID: GC/MS SemiVolatiles - G

Preparation: 3520C

Prep Batch: 680-49247

Lab File ID: g4951.d

Dilution: 1.0

Initial Weight/Volume: 1040 mL

Date Analyzed: 07/17/2006 1715

Final Weight/Volume: 1 mL

Date Prepared: 07/06/2006 1004

Injection Volume:

Analyte	Result (ug/L)	Qualifier	RL
Acenaphthene	9.6	U	9.6
Acenaphthylene	9.6	U	9.6
Acetophenone	9.6	U	9.6
2-Acetylaminofluorene	9.6	U	9.6
alpha, alpha-Dimethyl phenethylamine	1900	U	1900
4-Aminobiphenyl	9.6	U	9.6
Aniline	19	U	19
Anthracene	9.6	U	9.6
Aramite, Total	9.6	U	9.6
Benzo[a]anthracene	9.6	U	9.6
Benzo[a]pyrene	9.6	U	9.6
Benzo[b]fluoranthene	9.6	U	9.6
Benzo[g,h,i]perylene	9.6	U	9.6
Benzo[k]fluoranthene	9.6	U	9.6
Benzyl alcohol	9.6	U	9.6
1,1'-Biphenyl	9.6	U	9.6
Bis(2-chloroethoxy)methane	9.6	U	9.6
Bis(2-chloroethyl)ether	9.6	U	9.6
bis(chloroisopropyl) ether	9.6	U	9.6
Bis(2-ethylhexyl) phthalate	9.6	U	9.6
4-Bromophenyl phenyl ether	9.6	U	9.6
Butyl benzyl phthalate	9.6	U	9.6
4-Chloroaniline	19	U	19
4-Chloro-3-methylphenol	9.6	U	9.6
2-Chloronaphthalene	9.6	U	9.6
2-Chlorophenol	9.6	U	9.6
4-Chlorophenyl phenyl ether	9.6	U	9.6
Chrysene	9.6	U	9.6
Diallate	9.6	U	9.6
Dibenz(a,h)anthracene	9.6	U	9.6
Dibenzofuran	9.6	U	9.6
3,3'-Dichlorobenzidine	19	U	19
2,4-Dichlorophenol	9.6	U	9.6
2,6-Dichlorophenol	9.6	U	9.6
Diethyl phthalate	9.6	U	9.6
Dimethoate	9.6	U	9.6
7,12-Dimethylbenz(a)anthracene	9.6	U	9.6
3,3'-Dimethylbenzidine	19	U	19
2,4-Dimethylphenol	9.6	U	9.6
Dimethyl phthalate	9.6	U	9.6
Di-n-butyl phthalate	9.6	U	9.6
1,3-Dinitrobenzene	9.6	U	9.6
4,6-Dinitro-2-methylphenol	48	U	48

**Analytical Data**

Client: Solutia Inc.

Job Number: 680-18095-1

Sdg Number: KPM001

Client Sample ID: PMA1S-0606

Lab Sample ID: 680-18095-5

Date Sampled: 06/29/2006 1430

Client Matrix: Water

Date Received: 07/01/2006 0900

**8270C Semivolatile Compounds by Gas Chromatography/Mass Spectrometry (GC/MS)**

Method: 8270C

Analysis Batch: 680-50150

Instrument ID: GC/MS SemiVolatiles - G

Preparation: 3520C

Prep Batch: 680-49247

Lab File ID: g4951.d

Dilution: 1.0

Initial Weight/Volume: 1040 mL

Date Analyzed: 07/17/2006 1715

Final Weight/Volume: 1 mL

Date Prepared: 07/06/2006 1004

Injection Volume:

Analyte	Result (ug/L)	Qualifier	RL
2,4-Dinitrophenol	48	U	48
2,6-Dinitrotoluene	9.6	U	9.6
2,4-Dinitrotoluene	9.6	U	9.6
Di-n-octyl phthalate	9.6	U	9.6
Dinoseb	9.6	U	9.6
1,4-Dioxane	9.6	U	9.6
Disulfoton	9.6	U	9.6
Ethyl methanesulfonate	9.6	U	9.6
Famphur	9.6	U	9.6
Fluoranthene	9.6	U	9.6
Fluorene	9.6	U	9.6
Hexachlorobenzene	9.6	U	9.6
Hexachlorobutadiene	9.6	U	9.6
Hexachlorocyclopentadiene	9.6	U	9.6
Hexachloroethane	9.6	U	9.6
Hexachlorophene	4800	U	4800
Hexachloropropene	9.6	U	9.6
Indeno[1,2,3-cd]pyrene	9.6	U	9.6
Isophorone	9.6	U	9.6
Isosafrole	9.6	U	9.6
Methapyrilene	1900	U	1900
3-Methylcholanthrene	9.6	U	9.6
Methyl methanesulfonate	9.6	U	9.6
2-Methylnaphthalene	9.6	U	9.6
Methyl parathion	9.6	U	9.6
2-Methylphenol	9.6	U	9.6
3 & 4 Methylphenol	9.6	U	9.6
Naphthalene	9.6	U	9.6
1,4-Naphthoquinone	9.6	U	9.6
1-Naphthylamine	9.6	U	9.6
2-Naphthylamine	9.6	U	9.6
3-Nitroaniline	48	U	48
2-Nitroaniline	48	U	48
4-Nitroaniline	48	U	48
Nitrobenzene	9.6	U	9.6
4-Nitrophenol	48	U	48
2-Nitrophenol	9.6	U	9.6
4-Nitroquinoline-1-oxide	19	U	19
N-Nitro-o-toluidine	9.6	U	9.6
N-Nitrosodiethylamine	9.6	U	9.6
N-Nitrosodimethylamine	9.6	U	9.6
N-Nitrosodi-n-butylamine	9.6	U	9.6
N-Nitrosodi-n-propylamine	9.6	U	9.6

**Analytical Data**

Client: Solutia Inc.

Job Number: 680-18095-1

Sdg Number: KPM001

Client Sample ID: PMA1S-0606

Lab Sample ID: 680-18095-5

Date Sampled: 06/29/2006 1430

Client Matrix: Water

Date Received: 07/01/2006 0900

**8270C Semivolatile Compounds by Gas Chromatography/Mass Spectrometry (GC/MS)**

Method:	8270C	Analysis Batch:	680-50150	Instrument ID:	GC/MS SemiVolatiles - G
Preparation:	3520C	Prep Batch:	680-49247	Lab File ID:	g4951.d
Dilution:	1.0			Initial Weight/Volume:	1040 mL
Date Analyzed:	07/17/2006 1715			Final Weight/Volume:	1 mL
Date Prepared:	07/06/2006 1004			Injection Volume:	

Analyte	Result (ug/L)	Qualifier	RL
N-Nitrosodiphenylamine	9.6	U	9.6
n-Nitrosomethylethylamine	9.6	U	9.6
N-Nitrosomorpholine	9.6	U	9.6
N-Nitrosopiperidine	9.6	U	9.6
N-Nitrosopyrrolidine	9.6	U	9.6
o,o',o"-Triethylphosphorothioate	9.6	U	9.6
Parathion	9.6	U	9.6
p-Dimethylamino azobenzene	9.6	U	9.6
Pentachlorobenzene	9.6	U	9.6
Pentachloronitrobenzene	9.6	U	9.6
Pentachlorophenol	48	U	48
Phenacetin	9.6	U	9.6
Phenanthrene	9.6	U	9.6
Phenol	9.6	U	9.6
Phorate	9.6	U	9.6
2-Picoline	9.6	U	9.6
p-Phenylene diamine	1900	U	1900
Pronamide	9.6	U	9.6
Pyrene	9.6	U	9.6
Pyridine	48	U	48
Safole, Total	9.6	U	9.6
Sulfotepp	9.6	U	9.6
1,2,4,5-Tetrachlorobenzene	9.6	U	9.6
2,3,4,6-Tetrachlorophenol	9.6	U	9.6
Thionazin	9.6	U	9.6
2-Toluidine	9.6	U	9.6
1,2,4-Trichlorobenzene	9.6	U	9.6
2,4,5-Trichlorophenol	9.6	U	9.6
2,4,6-Trichlorophenol	9.6	U	9.6
1,3,5-Trinitrobenzene	9.6	U	9.6
1-Chloro-3-nitrobenzene	9.6	U	9.6
1-Chloro-4-nitrobenzene	9.6	U	9.6
1-Chloro-2-nitrobenzene	9.6	U	9.6
2-Nitrobiphenyl	9.6	U	9.6
2,4-Dichloronitrobenzene	9.6	U	9.6
3-Nitrobiphenyl	9.6	U	9.6
3,4-Dichloronitrobenzene	9.6	U	9.6
4-Nitrobiphenyl	9.6	U	9.6

Surrogate	%Rec	Acceptance Limits
2-Fluorobiphenyl	84	59 - 103
2-Fluorophenol	75	56 - 100
Nitrobenzene-d5	77	60 - 102
Phenol-d5	82	55 - 104

## Analytical Data

Client: Solutia Inc.

Job Number: 680-18095-1

Sdg Number: KPM001

Client Sample ID: PMA1S-0606

Lab Sample ID: 680-18095-5

Client Matrix: Water

Date Sampled: 06/29/2006 1430

Date Received: 07/01/2006 0900

### 8270C Semivolatile Compounds by Gas Chromatography/Mass Spectrometry (GC/MS)

Method: 8270C

Analysis Batch: 680-50150

Instrument ID: GC/MS SemiVolatiles - G

Preparation: 3520C

Prep Batch: 680-49247

Lab File ID: g4951.d

Dilution: 1.0

Initial Weight/Volume: 1040 mL

Date Analyzed: 07/17/2006 1715

Final Weight/Volume: 1 mL

Date Prepared: 07/06/2006 1004

Injection Volume:

Surrogate	%Rec	Acceptance Limits
Terphenyl-d14	109	10 - 154
2,4,6-Tribromophenol	90	55 - 126

**Analytical Data**

Client: Solutia Inc.

Job Number: 680-18095-1

Sdg Number: KPM001

Client Sample ID: PMA-2M-0606

Lab Sample ID: 680-18095-7

Date Sampled: 06/29/2006 1700

Client Matrix: Water

Date Received: 07/01/2006 0900

**8270C Semivolatile Compounds by Gas Chromatography/Mass Spectrometry (GC/MS)**

Method: 8270C

Analysis Batch: 680-50714

Instrument ID: GC/MS SemiVolatiles - G

Preparation: 3520C

Prep Batch: 680-49247

Lab File ID: g5059.d

Dilution: 1.0

Initial Weight/Volume: 1040 mL

Date Analyzed: 07/25/2006 1350

Final Weight/Volume: 1 mL

Date Prepared: 07/06/2006 1004

Injection Volume:

Analyte	Result (ug/L)	Qualifier	RL
Acenaphthene	9.6	U	9.6
Acenaphthylene	9.6	U	9.6
Acetophenone	9.6	U	9.6
2-Acetylaminofluorene	9.6	U	9.6
alpha,alpha-Dimethyl phenethylamine	1900	U	1900
4-Aminobiphenyl	9.6	U	9.6
Aniline	19	U	19
Anthracene	9.6	U	9.6
Aramite, Total	9.6	U	9.6
Benzo[a]anthracene	9.6	U	9.6
Benzo[a]pyrene	9.6	U	9.6
Benzo[b]fluoranthene	9.6	U	9.6
Benzo[g,h,i]perylene	9.6	U	9.6
Benzo[k]fluoranthene	9.6	U	9.6
Benzyl alcohol	9.6	U	9.6
1,1'-Biphenyl	9.6	U	9.6
Bis(2-chloroethoxy)methane	9.6	U	9.6
Bis(2-chloroethyl)ether	9.6	U	9.6
bis(chloroisopropyl) ether	9.6	U	9.6
Bis(2-ethylhexyl) phthalate	9.6	U	9.6
4-Bromophenyl phenyl ether	9.6	U	9.6
Butyl benzyl phthalate	9.6	U	9.6
4-Chloroaniline	150		19
4-Chloro-3-methylphenol	9.6	U	9.6
2-Chloronaphthalene	9.6	U	9.6
2-Chlorophenol	9.6	U	9.6
4-Chlorophenyl phenyl ether	9.6	U	9.6
Chrysene	9.6	U	9.6
Diallate	9.6	U	9.6
Dibenz(a,h)anthracene	9.6	U	9.6
Dibenzofuran	9.6	U	9.6
3,3'-Dichlorobenzidine	19	U	19
2,4-Dichlorophenol	9.6	U	9.6
2,6-Dichlorophenol	9.6	U	9.6
Diethyl phthalate	9.6	U	9.6
Dimethoate	9.6	U	9.6
7,12-Dimethylbenz(a)anthracene	9.6	U	9.6
3,3'-Dimethylbenzidine	19	U	19
2,4-Dimethylphenol	9.6	U	9.6
Dimethyl phthalate	9.6	U	9.6
Di-n-butyl phthalate	9.6	U	9.6
1,3-Dinitrobenzene	9.6	U	9.6
4,6-Dinitro-2-methylphenol	48	U	48

**Analytical Data**

Client: Solutia Inc.

Job Number: 680-18095-1

Sdg Number: KPM001

Client Sample ID: PMA-2M-0606

Lab Sample ID: 680-18095-7

Date Sampled: 06/29/2006 1700

Client Matrix: Water

Date Received: 07/01/2006 0900

**8270C Semivolatile Compounds by Gas Chromatography/Mass Spectrometry (GC/MS)**

Method: 8270C

Analysis Batch: 680-50714

Instrument ID: GC/MS SemiVolatiles - G

Preparation: 3520C

Prep Batch: 680-49247

Lab File ID: g5059.d

Dilution: 1.0

Initial Weight/Volume: 1040 mL

Date Analyzed: 07/25/2006 1350

Final Weight/Volume: 1 mL

Date Prepared: 07/06/2006 1004

Injection Volume:

Analyte	Result (ug/L)	Qualifier	RL
2,4-Dinitrophenol	48	U	48
2,6-Dinitrotoluene	9.6	U	9.6
2,4-Dinitrotoluene	9.6	U	9.6
Di-n-octyl phthalate	9.6	U	9.6
Dinoseb	9.6	U	9.6
1,4-Dioxane	9.6	U	9.6
Disulfoton	9.6	U	9.6
Ethyl methanesulfonate	9.6	U	9.6
Famphur	9.6	U	9.6
Fluoranthene	9.6	U	9.6
Fluorene	9.6	U	9.6
Hexachlorobenzene	9.6	U	9.6
Hexachlorobutadiene	9.6	U	9.6
Hexachlorocyclopentadiene	9.6	U	9.6
Hexachloroethane	9.6	U	9.6
Hexachlorophene	4800	U	4800
Hexachloropropene	9.6	U	9.6
Indeno[1,2,3-cd]pyrene	9.6	U	9.6
Isophorone	9.6	U	9.6
Isosafrole	9.6	U	9.6
Methapyrilene	1900	U	1900
3-Methylcholanthrene	9.6	U	9.6
Methyl methanesulfonate	9.6	U	9.6
2-Methylnaphthalene	9.6	U	9.6
Methyl parathion	9.6	U	9.6
2-Methylphenol	9.6	U	9.6
3 & 4 Methylphenol	9.6	U	9.6
Naphthalene	9.6	U	9.6
1,4-Naphthoquinone	9.6	U	9.6
1-Naphthylamine	9.6	U	9.6
2-Naphthylamine	9.6	U	9.6
3-Nitroaniline	48	U	48
2-Nitroaniline	48	U	48
4-Nitroaniline	48	U	48
Nitrobenzene	9.6	U	9.6
4-Nitrophenol	48	U	48
2-Nitrophenol	9.6	U	9.6
4-Nitroquinoline-1-oxide	19	U	19
N-Nitro-o-toluidine	9.6	U	9.6
N-Nitrosodiethylamine	9.6	U	9.6
N-Nitrosodimethylamine	9.6	U	9.6
N-Nitrosodi-n-butylamine	9.6	U	9.6
N-Nitrosodi-n-propylamine	9.6	U	9.6



**Analytical Data**

Client: Solutia Inc.

Job Number: 680-18095-1

Sdg Number: KPM001

Client Sample ID: PMA-2M-0606

Lab Sample ID: 680-18095-7

Date Sampled: 06/29/2006 1700

Client Matrix: Water

Date Received: 07/01/2006 0900

**8270C Semivolatile Compounds by Gas Chromatography/Mass Spectrometry (GC/MS)**

Method:	8270C	Analysis Batch:	680-50714	Instrument ID:	GC/MS SemiVolatiles - G
Preparation:	3520C	Prep Batch:	680-49247	Lab File ID:	g5059.d
Dilution:	1.0			Initial Weight/Volume:	1040 mL
Date Analyzed:	07/25/2006 1350			Final Weight/Volume:	1 mL
Date Prepared:	07/06/2006 1004			Injection Volume:	

Analyte	Result (ug/L)	Qualifier	RL
N-Nitrosodiphenylamine	9.6	U	9.6
n-Nitrosomethylethylamine	9.6	U	9.6
N-Nitrosomorpholine	9.6	U	9.6
N-Nitrosopiperidine	9.6	U	9.6
N-Nitrosopyrrolidine	9.6	U	9.6
o,o',o"-Triethylphosphorothioate	9.6	U	9.6
Parathion	9.6	U	9.6
p-Dimethylamino azobenzene	9.6	U	9.6
Pentachlorobenzene	9.6	U	9.6
Pentachloronitrobenzene	9.6	U	9.6
Pentachlorophenol	48	U	48
Phenacetin	9.6	U	9.6
Phenanthrene	9.6	U	9.6
Phenol	9.6	U	9.6
Phorate	9.6	U	9.6
2-Picoline	9.6	U	9.6
p-Phenylene diamine	1900	U	1900
Pronamide	9.6	U	9.6
Pyrene	9.6	U	9.6
Pyridine	48	U	48
Safrole, Total	9.6	U	9.6
Sulfotepp	9.6	U	9.6
1,2,4,5-Tetrachlorobenzene	9.6	U	9.6
2,3,4,6-Tetrachlorophenol	9.6	U	9.6
Thionazin	9.6	U	9.6
2-Toluidine	9.6	U	9.6
1,2,4-Trichlorobenzene	9.6	U	9.6
2,4,5-Trichlorophenol	9.6	U	9.6
2,4,6-Trichlorophenol	9.6	U	9.6
1,3,5-Trinitrobenzene	9.6	U	9.6
1-Chloro-3-nitrobenzene	9.6	U	9.6
1-Chloro-4-nitrobenzene	9.6	U	9.6
1-Chloro-2-nitrobenzene	9.6	U	9.6
2-Nitrobiphenyl	9.6	U	9.6
2,4-Dichloronitrobenzene	9.6	U	9.6
3-Nitrobiphenyl	9.6	U	9.6
3,4-Dichloronitrobenzene	9.6	U	9.6
4-Nitrobiphenyl	9.6	U	9.6

Surrogate	%Rec	Acceptance Limits
2-Fluorobiphenyl	73	59 - 103
2-Fluorophenol	74	56 - 100
Nitrobenzene-d5	66	60 - 102
Phenol-d5	70	55 - 104

**Analytical Data**

Client: Solutia Inc.

Job Number: 680-18095-1

Sdg Number: KPM001

Client Sample ID: PMA-2M-0606

Lab Sample ID: 680-18095-7

Client Matrix: Water

Date Sampled: 06/29/2006 1700

Date Received: 07/01/2006 0900

**8270C Semivolatile Compounds by Gas Chromatography/Mass Spectrometry (GC/MS)**

Method: 8270C

Analysis Batch: 680-50714

Instrument ID: GC/MS SemiVolatiles - G

Preparation: 3520C

Prep Batch: 680-49247

Lab File ID: g5059.d

Dilution: 1.0

Initial Weight/Volume: 1040 mL

Date Analyzed: 07/25/2006 1350

Final Weight/Volume: 1 mL

Date Prepared: 07/06/2006 1004

Injection Volume:

Surrogate	%Rec	Acceptance Limits
Terphenyl-d14	57	10 - 154
2,4,6-Tribromophenol	112	55 - 126

# Analytical Data

Client: Solutia Inc.

Job Number: 680-18095-1

Sdg Number: KPM001

Client Sample ID: PMA-2M-0606-AD

Lab Sample ID: 680-18095-8FD

Date Sampled: 06/29/2006 1700

Client Matrix: Water

Date Received: 07/01/2006 0900

## 8270C Semivolatile Compounds by Gas Chromatography/Mass Spectrometry (GC/MS)

Method: 8270C

Analysis Batch: 680-50714

Instrument ID: GC/MS SemiVolatiles - G

Preparation: 3520C

Prep Batch: 680-49247

Lab File ID: g5060.d

Dilution: 1.0

Initial Weight/Volume: 1040 mL

Date Analyzed: 07/25/2006 1416

Final Weight/Volume: 1 mL

Date Prepared: 07/06/2006 1004

Injection Volume:

Analyte	Result (ug/L)	Qualifier	RL
Acenaphthene	9.6	U	9.6
Acenaphthylene	9.6	U	9.6
Acetophenone	9.6	U	9.6
2-Acetylaminofluorene	9.6	U	9.6
alpha,alpha-Dimethyl phenethylamine	1900	U	1900
4-Aminobiphenyl	9.6	U	9.6
Aniline	19	U	19
Anthracene	9.6	U	9.6
Aramite, Total	9.6	U	9.6
Benzo[a]anthracene	9.6	U	9.6
Benzo[a]pyrene	9.6	U	9.6
Benzo[b]fluoranthene	9.6	U	9.6
Benzo[g,h,i]perylene	9.6	U	9.6
Benzo[k]fluoranthene	9.6	U	9.6
Benzyl alcohol	9.6	U	9.6
1,1'-Biphenyl	9.6	U	9.6
Bis(2-chloroethoxy)methane	9.6	U	9.6
Bis(2-chloroethyl)ether	9.6	U	9.6
bis(chloroisopropyl) ether	9.6	U	9.6
Bis(2-ethylhexyl) phthalate	9.6	U	9.6
4-Bromophenyl phenyl ether	9.6	U	9.6
Butyl benzyl phthalate	9.6	U	9.6
4-Chloroaniline	200	E	19 *
4-Chloro-3-methylphenol	9.6	U	9.6
2-Chloronaphthalene	9.6	U	9.6
2-Chlorophenol	9.6	U	9.6
4-Chlorophenyl phenyl ether	9.6	U	9.6
Chrysene	9.6	U	9.6
Diallate	9.6	U	9.6
Dibenz(a,h)anthracene	9.6	U	9.6
Dibenzofuran	9.6	U	9.6
3,3'-Dichlorobenzidine	19	U	19
2,4-Dichlorophenol	9.6	U	9.6
2,6-Dichlorophenol	9.6	U	9.6
Diethyl phthalate	9.6	U	9.6
Dimethoate	9.6	U	9.6
7,12-Dimethylbenz(a)anthracene	9.6	U	9.6
3,3'-Dimethylbenzidine	19	U	19
2,4-Dimethylphenol	9.6	U	9.6
Dimethyl phthalate	9.6	U	9.6
Di-n-butyl phthalate	9.6	U	9.6
1,3-Dinitrobenzene	9.6	U	9.6
4,6-Dinitro-2-methylphenol	48	U	48

**Analytical Data**

Client: Solutia Inc.

Job Number: 680-18095-1

Sdg Number: KPM001

Client Sample ID: PMA-2M-0606-AD

Lab Sample ID: 680-18095-8FD

Date Sampled: 06/29/2006 1700

Client Matrix: Water

Date Received: 07/01/2006 0900

**8270C Semivolatile Compounds by Gas Chromatography/Mass Spectrometry (GC/MS)**

Method:	8270C	Analysis Batch:	680-50714	Instrument ID:	GC/MS SemiVolatiles - G
Preparation:	3520C	Prep Batch:	680-49247	Lab File ID:	g5060.d
Dilution:	1.0			Initial Weight/Volume:	1040 mL
Date Analyzed:	07/25/2006 1416			Final Weight/Volume:	1 mL
Date Prepared:	07/06/2006 1004			Injection Volume:	

Analyte	Result (ug/L)	Qualifier	RL
2,4-Dinitrophenol	48	U	48
2,6-Dinitrotoluene	9.6	U	9.6
2,4-Dinitrotoluene	9.6	U	9.6
Di-n-octyl phthalate	9.6	U	9.6
Dinoseb	9.6	U	9.6
1,4-Dioxane	9.6	U	9.6
Disulfoton	9.6	U	9.6
Ethyl methanesulfonate	9.6	U	9.6
Famphur	9.6	U	9.6
Fluoranthene	9.6	U	9.6
Fluorene	9.6	U	9.6
Hexachlorobenzene	9.6	U	9.6
Hexachlorobutadiene	9.6	U	9.6
Hexachlorocyclopentadiene	9.6	U	9.6
Hexachloroethane	9.6	U	9.6
Hexachlorophene	4800	U	4800
Hexachloropropene	9.6	U	9.6
Indeno[1,2,3-cd]pyrene	9.6	U	9.6
Isophorone	9.6	U	9.6
Isosafrole	9.6	U	9.6
Methapyrilene	1900	U	1900
3-Methylcholanthrene	9.6	U	9.6
Methyl methanesulfonate	9.6	U	9.6
2-Methylnaphthalene	9.6	U	9.6
Methyl parathion	9.6	U	9.6
2-Methylphenol	9.6	U	9.6
3 & 4 Methylphenol	9.6	U	9.6
Naphthalene	9.6	U	9.6
1,4-Naphthoquinone	9.6	U	9.6
1-Naphthylamine	9.6	U	9.6
2-Naphthylamine	9.6	U	9.6
3-Nitroaniline	48	U	48
2-Nitroaniline	48	U	48
4-Nitroaniline	48	U	48
Nitrobenzene	9.6	U	9.6
4-Nitrophenol	48	U	48
2-Nitrophenol	9.6	U	9.6
4-Nitroquinoline-1-oxide	19	U	19
N-Nitro-o-toluidine	9.6	U	9.6
N-Nitrosodiethylamine	9.6	U	9.6
N-Nitrosodimethylamine	9.6	U	9.6
N-Nitrosodi-n-butylamine	9.6	U	9.6
N-Nitrosodi-n-propylamine	9.6	U	9.6

**Analytical Data**

Client: Solutia Inc.

Job Number: 680-18095-1

Sdg Number: KPM001

Client Sample ID: PMA-2M-0606-AD

Lab Sample ID: 680-18095-8FD

Date Sampled: 06/29/2006 1700

Client Matrix: Water

Date Received: 07/01/2006 0900

**8270C Semivolatile Compounds by Gas Chromatography/Mass Spectrometry (GC/MS)**

Method: 8270C

Analysis Batch: 680-50714

Instrument ID: GC/MS SemiVolatiles - G

Preparation: 3520C

Prep Batch: 680-49247

Lab File ID: g5060.d

Dilution: 1.0

Initial Weight/Volume: 1040 mL

Date Analyzed: 07/25/2006 1416

Final Weight/Volume: 1 mL

Date Prepared: 07/06/2006 1004

Injection Volume:

Analyte	Result (ug/L)	Qualifier	RL
N-Nitrosodiphenylamine	9.6	U	9.6
n-Nitrosomethylethylamine	9.6	U	9.6
N-Nitrosomorpholine	9.6	U	9.6
N-Nitrosopiperidine	9.6	U	9.6
N-Nitrosopyrrolidine	9.6	U	9.6
o,o',o"-Triethylphosphorothioate	9.6	U	9.6
Parathion	9.6	U	9.6
p-Dimethylamino azobenzene	9.6	U	9.6
Pentachlorobenzene	9.6	U	9.6
Pentachloronitrobenzene	9.6	U	9.6
Pentachlorophenol	48	U	48
Phenacetin	9.6	U	9.6
Phenanthrene	9.6	U	9.6
Phenol	11		9.6
Phorate	9.6	U	9.6
2-Picoline	9.6	U	9.6
p-Phenylene diamine	1900	U	1900
Pronamide	9.6	U	9.6
Pyrene	9.6	U	9.6
Pyridine	48	U	48
Safrole, Total	9.6	U	9.6
Sulfotep	9.6	U	9.6
1,2,4,5-Tetrachlorobenzene	9.6	U	9.6
2,3,4,6-Tetrachlorophenol	9.6	U	9.6
Thionazin	9.6	U	9.6
2-Toluidine	9.6	U	9.6
1,2,4-Trichlorobenzene	9.6	U	9.6
2,4,5-Trichlorophenol	9.6	U	9.6
2,4,6-Trichlorophenol	9.6	U	9.6
1,3,5-Trinitrobenzene	9.6	U	9.6
Surrogate	%Rec	Acceptance Limits	
2-Fluorobiphenyl	87	59 - 103	
2-Fluorophenol	84	56 - 100	
Nitrobenzene-d5	77	60 - 102	
Phenol-d5	87	55 - 104	
Terphenyl-d14	88	10 - 154	
2,4,6-Tribromophenol	123	55 - 126	

\* Please see  
pages 66, 67 and 68  
for all data except  
4-Chloroaniline

# Analytical Data

Job Number: 680-18095-1  
Sdg Number: KPM001

Client: Solutia Inc.

Client Sample ID: PMA-2M-0606-AD

Lab Sample ID: 680-18095-8FD

Client Matrix: Water

Date Sampled: 06/29/2006 1700

Date Received: 07/01/2006 0900

## 8270C Semivolatile Compounds by Gas Chromatography/Mass Spectrometry (GC/MS)

Method:	8270C	Analysis Batch:	680-50150	Instrument ID:	GC/MS SemiVolatiles - G
Preparation:	3520C	Prep Batch:	680-49247	Lab File ID:	g4953.d
Dilution:	5.0			Initial Weight/Volume:	1040 mL
Date Analyzed:	07/17/2006 1807	Run Type:	DL	Final Weight/Volume:	1 mL
Date Prepared:	07/06/2006 1004			Injection Volume:	

Analyte	Result (ug/L)	Qualifier	RL
Acenaphthene	48	U	48
Acenaphthylene	48	U	48
Acetophenone	48	U	48
2-Acetylaminofluorene	48	U	48
alpha,alpha-Dimethyl phenethylamine	9600	U	9600
4-Aminobiphenyl	48	U	48
Aniline	96	U	96
Anthracene	48	U	48
Aramite, Total	48	U	48
Benzo[a]anthracene	48	U	48
Benzo[a]pyrene	48	U	48
Benzo[b]fluoranthene	48	U	48
Benzo[g,h,i]perylene	48	U	48
Benzo[k]fluoranthene	48	U	48
Benzyl alcohol	48	U	48
1,1'-Biphenyl	48	U	48
Bis(2-chloroethoxy)methane	48	U	48
Bis(2-chloroethyl)ether	48	U	48
bis(chloroisopropyl) ether	48	U	48
Bis(2-ethylhexyl) phthalate	48	U	48
4-Bromophenyl phenyl ether	48	U	48
Butyl benzyl phthalate	48	U	48
* 4-Chloroaniline	160	D	96
4-Chloro-3-methylphenol	48	U	48
2-Chloronaphthalene	48	U	48
2-Chlorophenol	48	U	48
4-Chlorophenyl phenyl ether	48	U	48
Chrysene	48	U	48
Diallate	48	U	48
Dibenz(a,h)anthracene	48	U	48
Dibenzofuran	48	U	48
3,3'-Dichlorobenzidine	96	U	96
2,4-Dichlorophenol	48	U	48
2,6-Dichlorophenol	48	U	48
Diethyl phthalate	48	U	48
Dimethoate	48	U	48
7,12-Dimethylbenz(a)anthracene	48	U	48
3,3'-Dimethylbenzidine	96	U	96
2,4-Dimethylphenol	48	U	48
Dimethyl phthalate	48	U	48
Di-n-butyl phthalate	48	U	48
1,3-Dinitrobenzene	48	U	48
4,6-Dinitro-2-methylphenol	240	U	240



**Analytical Data**

Client: Solutia Inc.

Job Number: 680-18095-1

Sdg Number: KPM001

Client Sample ID: PMA-2M-0606-AD

Lab Sample ID: 680-18095-8FD

Date Sampled: 06/29/2006 1700

Client Matrix: Water

Date Received: 07/01/2006 0900

**8270C Semivolatile Compounds by Gas Chromatography/Mass Spectrometry (GC/MS)**

Method: 8270C

Analysis Batch: 680-50150

Instrument ID: GC/MS SemiVolatiles - G

Preparation: 3520C

Prep Batch: 680-49247

Lab File ID: g4953.d

Dilution: 5.0

Initial Weight/Volume: 1040 mL

Date Analyzed: 07/17/2006 1807

Run Type: DL

Final Weight/Volume: 1 mL

Date Prepared: 07/06/2006 1004

Injection Volume:

Analyte	Result (ug/L)	Qualifier	RL
2,4-Dinitrophenol	240	U	240
2,6-Dinitrotoluene	48	U	48
2,4-Dinitrotoluene	48	U	48
Di-n-octyl phthalate	48	U	48
Dinoseb	48	U	48
1,4-Dioxane	48	U	48
Disulfoton	48	U	48
Ethyl methanesulfonate	48	U	48
Famphur	48	U	48
Fluoranthene	48	U	48
Fluorene	48	U	48
Hexachlorobenzene	48	U	48
Hexachlorobutadiene	48	U	48
Hexachlorocyclopentadiene	48	U	48
Hexachloroethane	48	U	48
Hexachlorophene	24000	U	24000
Hexachloropropene	48	U	48
Indeno[1,2,3-cd]pyrene	48	U	48
Isophorone	48	U	48
Isosafrole	48	U	48
Methapyrilene	9600	U	9600
3-Methylcholanthrene	48	U	48
Methyl methanesulfonate	48	U	48
2-Methylnaphthalene	48	U	48
Methyl parathion	48	U	48
2-Methylphenol	48	U	48
3 & 4 Methylphenol	48	U	48
Naphthalene	48	U	48
1,4-Naphthoquinone	48	U	48
1-Naphthylamine	48	U	48
2-Naphthylamine	48	U	48
3-Nitroaniline	240	U	240
2-Nitroaniline	240	U	240
4-Nitroaniline	240	U	240
Nitrobenzene	48	U	48
4-Nitrophenol	240	U	240
2-Nitrophenol	48	U	48
4-Nitroquinoline-1-oxide	96	U	96
N-Nitro-o-toluidine	48	U	48
N-Nitrosodiethylamine	48	U	48
N-Nitrosodimethylamine	48	U	48
N-Nitrosodi-n-butylamine	48	U	48
N-Nitrosodi-n-propylamine	48	U	48

# Analytical Data

Client: Solutia Inc.

Job Number: 680-18095-1

Sdg Number: KPM001

Client Sample ID: PMA-2M-0606-AD

Lab Sample ID: 680-18095-8FD

Date Sampled: 06/29/2006 1700

Client Matrix: Water

Date Received: 07/01/2006 0900

## 8270C Semivolatile Compounds by Gas Chromatography/Mass Spectrometry (GC/MS)

Method:	8270C	Analysis Batch:	680-50150	Instrument ID:	GC/MS SemiVolatiles - G
Preparation:	3520C	Prep Batch:	680-49247	Lab File ID:	g4953.d
Dilution:	5.0			Initial Weight/Volume:	1040 mL
Date Analyzed:	07/17/2006 1807	Run Type:	DL	Final Weight/Volume:	1 mL
Date Prepared:	07/06/2006 1004			Injection Volume:	

Analyte	Result (ug/L)	Qualifier	RL
N-Nitrosodiphenylamine	48	U	48
n-Nitrosomethylethylamine	48	U	48
N-Nitrosomorpholine	48	U	48
N-Nitrosopiperidine	48	U	48
N-Nitrosopyrrolidine	48	U	48
o,o',o"-Triethylphosphorothioate	48	U	48
Parathion	48	U	48
p-Dimethylamino azobenzene	48	U	48
Pentachlorobenzene	48	U	48
Pentachloronitrobenzene	48	U	48
Pentachlorophenol	240	U	240
Phenacetin	48	U	48
Phenanthrene	48	U	48
Phenol	48	U	48
Phorate	48	U	48
2-Picoline	48	U	48
p-Phenylene diamine	9600	U	9600
Pronamide	48	U	48
Pyrene	48	U	48
Pyridine	240	U	240
Safrole, Total	48	U	48
Sulfotepp	48	U	48
1,2,4,5-Tetrachlorobenzene	48	U	48
2,3,4,6-Tetrachlorophenol	48	U	48
Thionazin	48	U	48
2-Toluidine	48	U	48
1,2,4-Trichlorobenzene	48	U	48
2,4,5-Trichlorophenol	48	U	48
2,4,6-Trichlorophenol	48	U	48
1,3,5-Trinitrobenzene	48	U	48
1-Chloro-3-nitrobenzene	48	U	48
1-Chloro-4-nitrobenzene	48	U	48
1-Chloro-2-nitrobenzene	48	U	48
2-Nitrobiphenyl	48	U	48
2,4-Dichloronitrobenzene	48	U	48
3-Nitrobiphenyl	48	U	48
3,4-Dichloronitrobenzene	48	U	48
4-Nitrobiphenyl	48	U	48

Surrogate	%Rec	Acceptance Limits
2-Fluorobiphenyl	0 D	59 - 103
2-Fluorophenol	58	56 - 100
Nitrobenzene-d5	0 D	60 - 102
Phenol-d5	57	55 - 104

## Analytical Data

Client: Solutia Inc.

Job Number: 680-18095-1

Sdg Number: KPM001

Client Sample ID: PMA-2M-0606-AD

Lab Sample ID: 680-18095-8FD

Client Matrix: Water

Date Sampled: 06/29/2006 1700

Date Received: 07/01/2006 0900

### 8270C Semivolatile Compounds by Gas Chromatography/Mass Spectrometry (GC/MS)

Method: 8270C

Analysis Batch: 680-50150

Instrument ID: GC/MS SemiVolatiles - G

Preparation: 3520C

Prep Batch: 680-49247

Lab File ID: g4953.d

Dilution: 5.0

Initial Weight/Volume: 1040 mL

Date Analyzed: 07/17/2006 1807

Run Type: DL

Final Weight/Volume: 1 mL

Date Prepared: 07/06/2006 1004

Injection Volume:

Surrogate

%Rec

Acceptance Limits

Terphenyl-d14

0

D

10 - 154

2,4,6-Tribromophenol

63

55 - 126

**Analytical Data**

Client: Solutia Inc.

Job Number: 680-18095-1

Sdg Number: KPM001

Client Sample ID: PMA2S-0606

Lab Sample ID: 680-18095-11

Date Sampled: 06/30/2006 0845

Client Matrix: Water

Date Received: 07/01/2006 0900

**8270C Semivolatile Compounds by Gas Chromatography/Mass Spectrometry (GC/MS)**

Method:	8270C	Analysis Batch:	680-50714	Instrument ID:	GC/MS SemiVolatiles - G
Preparation:	3520C	Prep Batch:	680-49247	Lab File ID:	g5061.d
Dilution:	1.0			Initial Weight/Volume:	1060 mL
Date Analyzed:	07/25/2006 1442			Final Weight/Volume:	1 mL
Date Prepared:	07/06/2006 1004			Injection Volume:	

Analyte	Result (ug/L)	Qualifier	RL
Acenaphthene	9.4	U	9.4
Acenaphthylene	9.4	U	9.4
Acetophenone	9.4	U	9.4
2-Acetylaminofluorene	9.4	U	9.4
alpha,alpha-Dimethyl phenethylamine	1900	U	1900
4-Aminobiphenyl	9.4	U	9.4
Aniline	19	U	19
Anthracene	9.4	U	9.4
Aramite, Total	9.4	U	9.4
Benzo[a]anthracene	9.4	U	9.4
Benzo[a]pyrene	9.4	U	9.4
Benzo[b]fluoranthene	9.4	U	9.4
Benzo[g,h,i]perylene	9.4	U	9.4
Benzo[k]fluoranthene	9.4	U	9.4
Benzyl alcohol	9.4	U	9.4
1,1'-Biphenyl	9.4	U	9.4
Bis(2-chloroethoxy)methane	9.4	U	9.4
Bis(2-chloroethyl)ether	9.4	U	9.4
bis(chloroisopropyl) ether	9.4	U	9.4
Bis(2-ethylhexyl) phthalate	9.4	U	9.4
4-Bromophenyl phenyl ether	9.4	U	9.4
Butyl benzyl phthalate	9.4	U	9.4
4-Chloroaniline	19	U	19
4-Chloro-3-methylphenol	9.4	U	9.4
2-Chloronaphthalene	9.4	U	9.4
2-Chlorophenol	9.4	U	9.4
4-Chlorophenyl phenyl ether	9.4	U	9.4
Chrysene	9.4	U	9.4
Diallate	9.4	U	9.4
Dibenz(a,h)anthracene	9.4	U	9.4
Dibenzofuran	9.4	U	9.4
3,3'-Dichlorobenzidine	19	U	19
2,4-Dichlorophenol	9.4	U	9.4
2,6-Dichlorophenol	9.4	U	9.4
Diethyl phthalate	9.4	U	9.4
Dimethoate	9.4	U	9.4
7,12-Dimethylbenz(a)anthracene	9.4	U	9.4
3,3'-Dimethylbenzidine	19	U	19
2,4-Dimethylphenol	9.4	U	9.4
Dimethyl phthalate	9.4	U	9.4
Di-n-butyl phthalate	9.4	U	9.4
1,3-Dinitrobenzene	9.4	U	9.4
4,6-Dinitro-2-methylphenol	47	U	47

**Analytical Data**

Client: Solutia Inc.

Job Number: 680-18095-1

Sdg Number: KPM001

Client Sample ID: PMA2S-0606

Lab Sample ID: 680-18095-11

Date Sampled: 06/30/2006 0845

Client Matrix: Water

Date Received: 07/01/2006 0900

**8270C Semivolatile Compounds by Gas Chromatography/Mass Spectrometry (GC/MS)**

Method:	8270C	Analysis Batch: 680-50714	Instrument ID:	GC/MS SemiVolatiles - G
Preparation:	3520C	Prep Batch: 680-49247	Lab File ID:	g5061.d
Dilution:	1.0		Initial Weight/Volume:	1060 mL
Date Analyzed:	07/25/2006 1442		Final Weight/Volume:	1 mL
Date Prepared:	07/06/2006 1004		Injection Volume:	

Analyte	Result (ug/L)	Qualifier	RL
2,4-Dinitrophenol	47	U	47
2,6-Dinitrotoluene	9.4	U	9.4
2,4-Dinitrotoluene	9.4	U	9.4
Di-n-octyl phthalate	9.4	U	9.4
Dinoseb	9.4	U	9.4
1,4-Dioxane	9.4	U	9.4
Disulfoton	9.4	U	9.4
Ethyl methanesulfonate	9.4	U	9.4
Famphur	9.4	U	9.4
Fluoranthene	9.4	U	9.4
Fluorene	9.4	U	9.4
Hexachlorobenzene	9.4	U	9.4
Hexachlorobutadiene	9.4	U	9.4
Hexachlorocyclopentadiene	9.4	U	9.4
Hexachloroethane	9.4	U	9.4
Hexachlorophene	4700	U	4700
Hexachloropropene	9.4	U	9.4
Indeno[1,2,3-cd]pyrene	9.4	U	9.4
Isophorone	9.4	U	9.4
Isosafrole	9.4	U	9.4
Methapyrilene	1900	U	1900
3-Methylcholanthrene	9.4	U	9.4
Methyl methanesulfonate	9.4	U	9.4
2-Methylnaphthalene	9.4	U	9.4
Methyl parathion	9.4	U	9.4
2-Methylphenol	9.4	U	9.4
3 & 4 Methylphenol	9.4	U	9.4
Naphthalene	9.4	U	9.4
1,4-Naphthoquinone	9.4	U	9.4
1-Naphthylamine	9.4	U	9.4
2-Naphthylamine	9.4	U	9.4
3-Nitroaniline	47	U	47
2-Nitroaniline	47	U	47
4-Nitroaniline	47	U	47
Nitrobenzene	9.4	U	9.4
4-Nitrophenol	47	U	47
2-Nitrophenol	9.4	U	9.4
4-Nitroquinoline-1-oxide	19	U	19
N-Nitro-o-toluidine	9.4	U	9.4
N-Nitrosodiethylamine	9.4	U	9.4
N-Nitrosodimethylamine	9.4	U	9.4
N-Nitrosodi-n-butylamine	9.4	U	9.4
N-Nitrosodi-n-propylamine	9.4	U	9.4

# Analytical Data

Client: Solutia Inc.

Job Number: 680-18095-1

Sdg Number: KPM001

Client Sample ID: PMA2S-0606

Lab Sample ID: 680-18095-11

Client Matrix: Water

Date Sampled: 06/30/2006 0845

Date Received: 07/01/2006 0900

## 8270C Semivolatile Compounds by Gas Chromatography/Mass Spectrometry (GC/MS)

Method: 8270C

Analysis Batch: 680-50714

Instrument ID: GC/MS SemiVolatiles - G

Preparation: 3520C

Prep Batch: 680-49247

Lab File ID: g5061.d

Dilution: 1.0

Initial Weight/Volume: 1060 mL

Date Analyzed: 07/25/2006 1442

Final Weight/Volume: 1 mL

Date Prepared: 07/06/2006 1004

Injection Volume:

Analyte	Result (ug/L)	Qualifier	RL
N-Nitrosodiphenylamine	9.4	U	9.4
n-Nitrosomethylethylamine	9.4	U	9.4
N-Nitrosomorpholine	9.4	U	9.4
N-Nitrosopiperidine	9.4	U	9.4
N-Nitrosopyrrolidine	9.4	U	9.4
o,o',o"-Triethylphosphorothioate	9.4	U	9.4
Parathion	9.4	U	9.4
p-Dimethylamino azobenzene	9.4	U	9.4
Pentachlorobenzene	9.4	U	9.4
Pentachloronitrobenzene	9.4	U	9.4
Pentachlorophenol	47	U	47
Phenacetin	9.4	U	9.4
Phenanthrene	9.4	U	9.4
Phenol	9.4	U	9.4
Phorate	9.4	U	9.4
2-Picoline	9.4	U	9.4
p-Phenylene diamine	1900	U	1900
Pronamide	9.4	U	9.4
Pyrene	9.4	U	9.4
Pyridine	47	U	47
Safrole, Total	9.4	U	9.4
Sulfotepp	9.4	U	9.4
1,2,4,5-Tetrachlorobenzene	9.4	U	9.4
2,3,4,6-Tetrachlorophenol	9.4	U	9.4
Thionazin	9.4	U	9.4
2-Toluidine	9.4	U	9.4
1,2,4-Trichlorobenzene	9.4	U	9.4
2,4,5-Trichlorophenol	9.4	U	9.4
2,4,6-Trichlorophenol	9.4	U	9.4
1,3,5-Trinitrobenzene	9.4	U	9.4
1-Chloro-3-nitrobenzene	9.4	U	9.4
1-Chloro-4-nitrobenzene	9.4	U	9.4
1-Chloro-2-nitrobenzene	9.4	U	9.4
2-Nitrobiphenyl	9.4	U	9.4
2,4-Dichloronitrobenzene	9.4	U	9.4
3-Nitrobiphenyl	9.4	U	9.4
3,4-Dichloronitrobenzene	9.4	U	9.4
4-Nitrobiphenyl	9.4	U	9.4
Surrogate	%Rec		Acceptance Limits
2-Fluorobiphenyl	89		59 - 103
2-Fluorophenol	62		56 - 100
Nitrobenzene-d5	80		60 - 102
Phenol-d5	71		55 - 104

## Analytical Data

Client: Solutia Inc.

Job Number: 680-18095-1

Sdg Number: KPM001

Client Sample ID: PMA2S-0606

Lab Sample ID: 680-18095-11

Client Matrix: Water

Date Sampled: 06/30/2006 0845

Date Received: 07/01/2006 0900

### 8270C Semivolatile Compounds by Gas Chromatography/Mass Spectrometry (GC/MS)

Method: 8270C

Analysis Batch: 680-50714

Instrument ID: GC/MS SemiVolatiles - G

Preparation: 3520C

Prep Batch: 680-49247

Lab File ID: g5061.d

Dilution: 1.0

Initial Weight/Volume: 1060 mL

Date Analyzed: 07/25/2006 1442

Final Weight/Volume: 1 mL

Date Prepared: 07/06/2006 1004

Injection Volume:

Surrogate	%Rec	Acceptance Limits
Terphenyl-d14	105	10 - 154
2,4,6-Tribromophenol	98	55 - 126



## DATA REPORTING QUALIFIERS

Client: Solutia Inc.

Job Number: 680-18095-1

Sdg Number: KPM001

Lab Section	Qualifier	Description
GC/MS VOA		
	U	Indicates the analyte was analyzed for but not detected.
	F	MS or MSD exceeds the control limits
GC/MS Semi VOA		
	U	Indicates the analyte was analyzed for but not detected.
	F	MS or MSD exceeds the control limits
	E	Result exceeded calibration range, secondary dilution required.
	X	Surrogate exceeds the control limits
	D	Surrogate or matrix spike recoveries were not obtained because the extract was diluted for analysis; also compounds analyzed at a dilution will be flagged with a D.

**SDG KPM002**

**Results of Samples from Wells:**

**PMA-4S**

## ORGANIC DATA ASSESSMENT

PROJECT NUMBER: 21561601.00000

SITE: Solutia Krummrich

LABORATORY: STL Savannah

LAB PROJECT NO. 680-18197-1

REVIEWER: URS CORPORATION

NO. OF SAMPLES/

REVIEWER'S NAME: Tony Sedlacek

MATRIX: 3 samples/aqueous/1 filtered /1 unfiltered/ 1 Trip Blank

COMPLETION DATE: 8/25/2006

## DATA ASSESSMENT WORKSHEET

	VOCs Meth # 8260	SVOCs Meth # 8270	PCBs Meth # 680
1. HOLDING TIMES	✓	✓	✓
2. BLANKS	✓	✓	✓
3. SURROGATES	✓	(2)	✓
4. SCS (LCS)	✓	(3)	✓
5. DCS (LSCD)	N/A	N/A	N/A
6. MATRIX SPIKE/DUP	N/A	N/A	N/A
7. DILUTION	(1)	(4)	(5)
8. DUPLICATES	N/A	N/A	N/A
9. INTERNAL STANDARDS	✓	✓	(6)
10. OVERALL ASSESSMENT	O	M	O

O = Data had no problems/ or qualified due to minor problems.

M = Data qualified due to major problems.

Z = Data unacceptable.

X = Problems, but do not affect data.

N/A = Not applicable (Samples not submitted for analysis)

**ACTION ITEMS:** (3) LCS recoveries were outside evaluation criteria for Aniline (0%) with criteria (10-92%), N-Nitrosodimethylamine (47%) with criteria (50-137%) and pyridine (0%) with criteria of (10-178%) in LCS sample 680-49310/3-A. Aniline and pyridine were qualified rejected "R" and N-Nitrosodimethylamine was qualified estimated nondetect "UJ" in sample PMA4S-0606.

**COMMENTS:** (1) Due to high levels of target analytes the following sample was analyzed at a primary dilution: PMA4S-0606 (1:5). The following sample required secondary dilutions due to high levels of target analytes PMA4S-0606 (1:50). (2) Surrogates were not recoverable in sample PMA4S-0606DL because the sample was diluted (1:40) due to high levels of analytes, no qualification of data was required. (4) Due to high levels of target analytes the following sample required primary dilutions: PMA4S-0606 (1:40), no qualification of data was required. (5) Due to high levels of target analytes the following sample required primary dilutions: PMA4S-0606 (1:4), no qualification of data was required. (6) Internal standard phenanthrene-d10 recovered low outside evaluation criteria of  $\pm 30\%$  of the internal standard area in samples MB 680-49311 and PMA4S-0606-F. Internal standard chrysene-d12 recovered low outside evaluation criteria of  $\pm 30\%$  of the internal standard area in samples MB 680-49311, PMA4S-0606-F, PMA4S-0606, LCS-49311 and PMA4S-0606DL. All internal standard areas were

**KPM002**

**COMMENTS CONTINUED:** within evaluation criteria of  $\pm 50\%$  of the average ICAL internal standard area, therefore, no qualifications of data was required.

# **SAMPLE RESULTS**

\* Please see page 8

## Analytical Data

Client: Solutia Inc.

Job Number: 680-18197-1

Sdg Number: KPM002

Client Sample ID: PMA4S-0606

Lab Sample ID: 680-18197-2

Client Matrix: Water

Date Sampled: 06/30/2006 1200

Date Received: 07/06/2006 1310

### 8260B Volatile Organic Compounds by GC/MS

Method: 8260B

Analysis Batch: 680-49651

Instrument ID: GC/MS Volatiles - P

Preparation: 5030B

Lab File ID: p3701.d

Dilution: 5.0

Initial Weight/Volume: 5 mL

Date Analyzed: 07/12/2006 1719

Final Weight/Volume: 5 mL

Date Prepared: 07/12/2006 1719

Analyte	Result (ug/L)	Qualifier	RL
Acetone	130	U	130
Acetonitrile	200	U	200
Acrolein	100	U	100
Acrylonitrile	100	U	100
Benzene	16		5.0
Bromoform	5.0	U	5.0
Bromomethane	5.0	U	5.0
Carbon disulfide	10	U	10
Carbon tetrachloride	5.0	U	5.0
Chlorobenzene	300	E	5.0 *
2-Chloro-1,3-butadiene	5.0	U	5.0
Chlorodibromomethane	5.0	U	5.0
Chloroethane	5.0	U	5.0
Chloroform	5.0	U	5.0
Chloromethane	5.0	U	5.0
3-Chloro-1-propene	5.0	U	5.0
cis-1,3-Dichloropropene	5.0	U	5.0
1,2-Dibromo-3-Chloropropane	5.0	U	5.0
Dibromomethane	5.0	U	5.0
1,3-Dichlorobenzene	560	E	5.0 *
1,4-Dichlorobenzene	2700	E	5.0 *
1,2-Dichlorobenzene	320	E	5.0 *
Dichlorobromomethane	5.0	U	5.0
Dichlorodifluoromethane	5.0	U	5.0
1,2-Dichloroethane	5.0	U	5.0
1,1-Dichloroethane	5.0	U	5.0
1,1-Dichloroethene	5.0	U	5.0
1,2-Dichloropropane	5.0	U	5.0
Ethylbenzene	14		5.0
Ethylene Dibromide	5.0	U	5.0
Ethyl methacrylate	5.0	U	5.0
2-Hexanone	50	U	50
Iodomethane	25	U	25
Isobutanol	200	U	200
Methacrylonitrile	100	U	100
Methylene Chloride	25	U	25
Methyl Ethyl Ketone	50	U	50
methyl isobutyl ketone	50	U	50
Methyl methacrylate	5.0	U	5.0
Pentachloroethane	25	U	25
Propionitrile	100	U	100
Styrene	5.0	U	5.0
1,1,2,2-Tetrachloroethane	5.0	U	5.0

**Analytical Data**

Client: Solutia Inc.

Job Number: 680-18197-1

Sdg Number: KPM002

Client Sample ID: PMA4S-0606

Lab Sample ID: 680-18197-2

Client Matrix: Water

Date Sampled: 06/30/2006 1200

Date Received: 07/06/2006 1310

**8260B Volatile Organic Compounds by GC/MS**

Method: 8260B

Analysis Batch: 680-49651

Instrument ID: GC/MS Volatiles - P

Preparation: 5030B

Lab File ID: p3701.d

Dilution: 5.0

Initial Weight/Volume: 5 mL

Date Analyzed: 07/12/2006 1719

Final Weight/Volume: 5 mL

Date Prepared: 07/12/2006 1719

Analyte	Result (ug/L)	Qualifier	RL
1,1,1,2-Tetrachloroethane	5.0	U	5.0
Tetrachloroethene	5.0	U	5.0
Toluene	5.0	U	5.0
trans-1,4-Dichloro-2-butene	10	U	10
trans-1,2-Dichloroethene	5.0	U	5.0
trans-1,3-Dichloropropene	5.0	U	5.0
1,1,2-Trichloroethane	5.0	U	5.0
1,1,1-Trichloroethane	5.0	U	5.0
Trichloroethene	5.0	U	5.0
Trichlorofluoromethane	5.0	U	5.0
1,2,3-Trichloropropane	5.0	U	5.0
Vinyl acetate	10	U	10
Vinyl chloride	5.0	U	5.0
Xylenes, Total	10	U	10

Surrogate	%Rec	Acceptance Limits
4-Bromofluorobenzene	91	77 - 120
Dibromofluoromethane	89	75 - 123
Toluene-d8	102	79 - 122



\* Please see page 6  
for all data  
except that with  
a \*

# Analytical Data

Job Number: 680-18197-1

Sdg Number: KPM002

Client: Solutia Inc.

Client Sample ID: PMA4S-0606

Lab Sample ID: 680-18197-2

Client Matrix: Water

Date Sampled: 06/30/2006 1200

Date Received: 07/06/2006 1310

## 8260B Volatile Organic Compounds by GC/MS

Method: 8260B

Analysis Batch: 680-49766

Instrument ID: GC/MS Volatiles - P

Preparation: 5030B

Lab File ID: p3728.d

Dilution: 50

Initial Weight/Volume: 5 mL

Date Analyzed: 07/13/2006 1735

Run Type: DL

Final Weight/Volume: 5 mL

Date Prepared: 07/13/2006 1735

Analyte	Result (ug/L)	Qualifier	RL
Acetone	1300	U	1300
Acetonitrile	2000	U	2000
Acrolein	1000	U	1000
Acrylonitrile	1000	U	1000
Benzene	50	U	50
Bromoform	50	U	50
Bromomethane	50	U	50
Carbon disulfide	100	U	100
Carbon tetrachloride	50	U	50
Chlorobenzene	420	D	50 *
2-Chloro-1,3-butadiene	50	U	50
Chlorodibromomethane	50	U	50
Chloroethane	50	U	50
Chloroform	50	U	50
Chloromethane	50	U	50
3-Chloro-1-propene	50	U	50
cis-1,3-Dichloropropene	50	U	50
1,2-Dibromo-3-Chloropropane	50	U	50
Dibromomethane	50	U	50
1,3-Dichlorobenzene	680	D	50 *
1,4-Dichlorobenzene	3400	D	50 *
1,2-Dichlorobenzene	390	D	50 *
Dichlorobromomethane	50	U	50
Dichlorodifluoromethane	50	U	50
1,2-Dichloroethane	50	U	50
1,1-Dichloroethane	50	U	50
1,1-Dichloroethene	50	U	50
1,2-Dichloropropane	50	U	50
Ethylbenzene	50	U	50
Ethylene Dibromide	50	U	50
Ethyl methacrylate	50	U	50
2-Hexanone	500	U	500
Iodomethane	250	U	250
Isobutanol	2000	U	2000
Methacrylonitrile	1000	U	1000
Methylene Chloride	250	U	250
Methyl Ethyl Ketone	500	U	500
methyl isobutyl ketone	500	U	500
Methyl methacrylate	50	U	50
Pentachloroethane	250	U	250
Propionitrile	1000	U	1000
Styrene	50	U	50
1,1,2,2-Tetrachloroethane	50	U	50

**Analytical Data**

Client: Solutia Inc.

Job Number: 680-18197-1

Sdg Number: KPM002

Client Sample ID: PMA4S-0606

Lab Sample ID: 680-18197-2

Client Matrix: Water

Date Sampled: 06/30/2006 1200

Date Received: 07/06/2006 1310

**8260B Volatile Organic Compounds by GC/MS**

Method: 8260B

Analysis Batch: 680-49766

Instrument ID: GC/MS Volatiles - P

Preparation: 5030B

Lab File ID: p3728.d

Dilution: 50

Initial Weight/Volume: 5 mL

Date Analyzed: 07/13/2006 1735

Run Type: DL

Final Weight/Volume: 5 mL

Date Prepared: 07/13/2006 1735

Analyte	Result (ug/L)	Qualifier	RL
1,1,1,2-Tetrachloroethane	50	U	50
Tetrachloroethene	50	U	50
Toluene	50	U	50
trans-1,4-Dichloro-2-butene	100	U	100
trans-1,2-Dichloroethene	50	U	50
trans-1,3-Dichloropropene	50	U	50
1,1,2-Trichloroethane	50	U	50
1,1,1-Trichloroethane	50	U	50
Trichloroethene	50	U	50
Trichlorofluoromethane	50	U	50
1,2,3-Trichloropropane	50	U	50
Vinyl acetate	100	U	100
Vinyl chloride	50	U	50
Xylenes, Total	100	U	100

Surrogate	%Rec	Acceptance Limits
4-Bromofluorobenzene	102	77 - 120
Dibromofluoromethane	94	75 - 123
Toluene-d8	98	79 - 122

**Analytical Data**

Client: Solutia Inc.

Job Number: 680-18197-1

Sdg Number: KPM002

Client Sample ID: TB0705061

Lab Sample ID: 680-18197-3

Date Sampled: 06/30/2006 0000

Client Matrix: Water

Date Received: 07/06/2006 1310

**8260B Volatile Organic Compounds by GC/MS**

Method: 8260B  
Preparation: 5030B  
Dilution: 1.0  
Date Analyzed: 07/13/2006 1708  
Date Prepared: 07/13/2006 1708

Analysis Batch: 680-49766

Instrument ID: GC/MS Volatiles - P

Lab File ID: p3727.d

Initial Weight/Volume: 5 mL

Final Weight/Volume: 5 mL

Analyte	Result (ug/L)	Qualifier	RL
Acetone	25	U	25
Acetonitrile	40	U	40
Acrolein	20	U	20
Acrylonitrile	20	U	20
Benzene	1.0	U	1.0
Bromoform	1.0	U	1.0
Bromomethane	1.0	U	1.0
Carbon disulfide	2.0	U	2.0
Carbon tetrachloride	1.0	U	1.0
Chlorobenzene	1.0	U	1.0
2-Chloro-1,3-butadiene	1.0	U	1.0
Chlorodibromomethane	1.0	U	1.0
Chloroethane	1.0	U	1.0
Chloroform	1.0	U	1.0
Chloromethane	1.0	U	1.0
3-Chloro-1-propene	1.0	U	1.0
cis-1,3-Dichloropropene	1.0	U	1.0
1,2-Dibromo-3-Chloropropane	1.0	U	1.0
Dibromomethane	1.0	U	1.0
1,2-Dichlorobenzene	1.0	U	1.0
1,3-Dichlorobenzene	1.0	U	1.0
1,4-Dichlorobenzene	1.0	U	1.0
Dichlorobromomethane	1.0	U	1.0
Dichlorodifluoromethane	1.0	U	1.0
1,2-Dichloroethane	1.0	U	1.0
1,1-Dichloroethane	1.0	U	1.0
1,1-Dichloroethene	1.0	U	1.0
1,2-Dichloropropane	1.0	U	1.0
Ethylbenzene	1.0	U	1.0
Ethylene Dibromide	1.0	U	1.0
Ethyl methacrylate	1.0	U	1.0
2-Hexanone	10	U	10
Iodomethane	5.0	U	5.0
Isobutanol	40	U	40
Methacrylonitrile	20	U	20
Methylene Chloride	5.0	U	5.0
Methyl Ethyl Ketone	10	U	10
methyl isobutyl ketone	10	U	10
Methyl methacrylate	1.0	U	1.0
Pentachloroethane	5.0	U	5.0
Propionitrile	20	U	20
Styrene	1.0	U	1.0
1,1,2,2-Tetrachloroethane	1.0	U	1.0

**Analytical Data**

Client: Solutia Inc.

Job Number: 680-18197-1

Sdg Number: KPM002

Client Sample ID: TB0705061

Lab Sample ID: 680-18197-3

Client Matrix: Water

Date Sampled: 06/30/2006 0000

Date Received: 07/06/2006 1310

**8260B Volatile Organic Compounds by GC/MS**

Method: 8260B  
Preparation: 5030B  
Dilution: 1.0  
Date Analyzed: 07/13/2006 1708  
Date Prepared: 07/13/2006 1708

Analysis Batch: 680-49766

Instrument ID: GC/MS Volatiles - P

Lab File ID: p3727.d

Initial Weight/Volume: 5 mL

Final Weight/Volume: 5 mL

Analyte	Result (ug/L)	Qualifier	RL
1,1,1,2-Tetrachloroethane	1.0	U	1.0
Tetrachloroethene	1.0	U	1.0
Toluene	1.0	U	1.0
trans-1,4-Dichloro-2-butene	2.0	U	2.0
trans-1,2-Dichloroethene	1.0	U	1.0
trans-1,3-Dichloropropene	1.0	U	1.0
1,1,2-Trichloroethane	1.0	U	1.0
1,1,1-Trichloroethane	1.0	U	1.0
Trichloroethene	1.0	U	1.0
Trichlorofluoromethane	1.0	U	1.0
1,2,3-Trichloropropane	1.0	U	1.0
Vinyl acetate	2.0	U	2.0
Vinyl chloride	1.0	U	1.0
Xylenes, Total	2.0	U	2.0

Surrogate	%Rec	Acceptance Limits
4-Bromofluorobenzene	99	77 - 120
Dibromofluoromethane	103	75 - 123
Toluene-d8	98	79 - 122

## Analytical Data

Client: Solutia Inc.

Job Number: 680-18197-1

Sdg Number: KPM002

Client Sample ID: PMA4S-0606-F

Lab Sample ID: 680-18197-1

Date Sampled: 06/30/2006 1200

Client Matrix: Water

Date Received: 07/06/2006 1310

### 680 Polychlorinated Biphenyls by GCMS

Method: 680

Analysis Batch: 680-50694

Instrument ID: GC/MS SemiVolatiles - F

Preparation: 680\_P\_Liquid

Prep Batch: 680-49311

Lab File ID: N/A

Dilution: 1.0

Initial Weight/Volume: 1060 mL

Date Analyzed: 07/25/2006 1207

Final Weight/Volume: 1 mL

Date Prepared: 07/07/2006 0838

Injection Volume:

Analyte	Result (ug/L)	Qualifier	RL
Monochlorobiphenyl	0.094	U	0.094
Dichlorobiphenyl	0.094	U	0.094
Trichlorobiphenyl	0.094	U	0.094
Tetrachlorobiphenyl	0.19	U	0.19
Pentachlorobiphenyl	0.19	U	0.19
Hexachlorobiphenyl	0.19	U	0.19
Heptachlorobiphenyl	0.28	U	0.28
Octachlorobiphenyl	0.28	U	0.28
Nonachlorobiphenyl	0.47	U	0.47
DCB Decachlorobiphenyl	0.47	U	0.47
Surrogate	%Rec		Acceptance Limits
Decachlorobiphenyl-13C12	91		44 - 104

Please see  
page 13  
14

## Analytical Data

Client: Solutia Inc.

Job Number: 680-18197-1  
Sdg Number: KPM002

Client Sample ID: PMA4S-0606

Lab Sample ID: 680-18197-2

Client Matrix: Water

Date Sampled: 06/30/2006 1200

Date Received: 07/06/2006 1310

### 680 Polychlorinated Biphenyls by GCMS

Method: 680  
Preparation: 680\_P\_Liquid  
Dilution: 1.0  
Date Analyzed: 07/25/2006 1241  
Date Prepared: 07/07/2006 0838

Analysis Batch: 680-50694  
Prep Batch: 680-49311

Instrument ID: GC/MS SemiVolatiles - F  
Lab File ID: N/A  
Initial Weight/Volume: 1060 mL  
Final Weight/Volume: 1 mL  
Injection Volume:

Analyte	Result (ug/L)	Qualifier	RL
Monochlorobiphenyl	1.9		0.094
Dichlorobiphenyl	13	E	0.094 *
Trichlorobiphenyl	26	E	0.094 *
Tetrachlorobiphenyl	76	E	0.19 *
Pentachlorobiphenyl	50		0.19
Hexachlorobiphenyl	69	E	0.19 +
Heptachlorobiphenyl	45		0.28
Octachlorobiphenyl	11		0.28
Nonachlorobiphenyl	1.6		0.47
DCB Decachlorobiphenyl	0.64		0.47
Surrogate	%Rec		Acceptance Limits
Decachlorobiphenyl-13C12	87		44 - 104

**Analytical Data**

Client: Solutia Inc.

Job Number: 680-18197-1

Sdg Number: KPM002

*Please see  
page 13*

Client Sample ID: PMA4S-0606

Lab Sample ID: 680-18197-2

Client Matrix: Water

Date Sampled: 06/30/2006 1200

Date Received: 07/06/2006 1310

**680 Polychlorinated Biphenyls by GCMS**

Method: 680  
Preparation: 680\_P\_Liquid  
Dilution: 4.0  
Date Analyzed: 07/25/2006 1608  
Date Prepared: 07/07/2006 0838

Analysis Batch: 680-50694  
Prep Batch: 680-49311  
Run Type: DL

Instrument ID: GC/MS SemiVolatiles - F  
Lab File ID: N/A  
Initial Weight/Volume: 1060 mL  
Final Weight/Volume: 1 mL  
Injection Volume:

Analyte	Result (ug/L)	Qualifier	RL
Monochlorobiphenyl	1.8	D	0.38
Dichlorobiphenyl	10	D	0.38 *
Trichlorobiphenyl	27	D	0.38 *
Tetrachlorobiphenyl	58	D	0.75 *
Pentachlorobiphenyl	38	D	0.75
Hexachlorobiphenyl	53	D	0.75 *
Heptachlorobiphenyl	34	D	1.1
Octachlorobiphenyl	8.4	D	1.1
Nonachlorobiphenyl	6.5	D	1.9
DCB Decachlorobiphenyl	1.9	U	1.9
Surrogate	%Rec		Acceptance Limits
Decachlorobiphenyl-13C12	67		44 - 104



# Analytical Data

Client: Solutia Inc.

Job Number: 680-18197-1

Sdg Number: KPM002

Client Sample ID: PMA4S-0606

Lab Sample ID: 680-18197-2

Client Matrix: Water

Date Sampled: 06/30/2006 1200

Date Received: 07/06/2006 1310

## 8270C Semivolatile Compounds by Gas Chromatography/Mass Spectrometry (GC/MS)

Method: 8270C

Analysis Batch: 680-50150

Instrument ID: GC/MS SemiVolatiles - G

Preparation: 3520C

Prep Batch: 680-49310

Lab File ID: g4957.d

Dilution: 1.0

Initial Weight/Volume: 1060 mL

Date Analyzed: 07/17/2006 1950

Final Weight/Volume: 1 mL

Date Prepared: 07/07/2006 0832

Injection Volume:

Analyte	Result (ug/L)	Qualifier	RL
Acenaphthene	9.4	U	9.4
Acenaphthylene	9.4	U	9.4
Acetophenone	9.4	U	9.4
2-Acetylaminofluorene	9.4	U	9.4
alpha,alpha-Dimethyl phenethylamine	1900	U	1900
4-Aminobiphenyl	9.4	U	9.4
Aniline	19	U	19
Anthracene	9.4	U	9.4
Aramite, Total	9.4	U	9.4
Benzo[a]anthracene	9.4	U	9.4
Benzo[a]pyrene	9.4	U	9.4
Benzo[b]fluoranthene	9.4	U	9.4
Benzo[g,h,i]perylene	9.4	U	9.4
Benzo[k]fluoranthene	9.4	U	9.4
Benzyl alcohol	9.4	U	9.4
1,1'-Biphenyl	9.4	U	9.4
Bis(2-chloroethoxy)methane	9.4	U	9.4
Bis(2-chloroethyl)ether	9.4	U	9.4
bis(chloroisopropyl) ether	9.4	U	9.4
Bis(2-ethylhexyl) phthalate	9.4	U	9.4
4-Bromophenyl phenyl ether	9.4	U	9.4
Butyl benzyl phthalate	9.4	U	9.4
4-Chloroaniline	59	U	19
4-Chloro-3-methylphenol	9.4	U	9.4
2-Chloronaphthalene	9.4	U	9.4
2-Chlorophenol	9.4	U	9.4
4-Chlorophenyl phenyl ether	9.4	U	9.4
Chrysene	9.4	U	9.4
Diallate	9.4	U	9.4
Dibenz(a,h)anthracene	9.4	U	9.4
Dibenzofuran	9.4	U	9.4
3,3'-Dichlorobenzidine	19	U	19
2,4-Dichlorophenol	9.4	U	9.4
2,6-Dichlorophenol	9.4	U	9.4
Diethyl phthalate	9.4	U	9.4
Dimethoate	9.4	U	9.4
7,12-Dimethylbenz(a)anthracene	9.4	U	9.4
3,3'-Dimethylbenzidine	19	U	19
2,4-Dimethylphenol	9.4	U	9.4
Dimethyl phthalate	9.4	U	9.4
Di-n-butyl phthalate	9.4	U	9.4
1,3-Dinitrobenzene	9.4	U	9.4
4,6-Dinitro-2-methylphenol	47	U	47

**Analytical Data**

Client: Solutia Inc.

Job Number: 680-18197-1

Sdg Number: KPM002

Client Sample ID: PMA4S-0606

Lab Sample ID: 680-18197-2

Date Sampled: 06/30/2006 1200

Client Matrix: Water

Date Received: 07/06/2006 1310

**8270C Semivolatile Compounds by Gas Chromatography/Mass Spectrometry (GC/MS)**

Method:	8270C	Analysis Batch:	680-50150	Instrument ID:	GC/MS SemiVolatiles - G
Preparation:	3520C	Prep Batch:	680-49310	Lab File ID:	g4957.d
Dilution:	1.0			Initial Weight/Volume:	1060 mL
Date Analyzed:	07/17/2006 1950			Final Weight/Volume:	1 mL
Date Prepared:	07/07/2006 0832			Injection Volume:	

Analyte	Result (ug/L)	Qualifier	RL
2,4-Dinitrophenol	47	U	47
2,6-Dinitrotoluene	9.4	U	9.4
2,4-Dinitrotoluene	9.4	U	9.4
Di-n-octyl phthalate	9.4	U	9.4
Dinoseb	9.4	U	9.4
1,4-Dioxane	9.4	U	9.4
Disulfoton	9.4	U	9.4
Ethyl methanesulfonate	9.4	U	9.4
Famphur	9.4	U	9.4
Fluoranthene	9.4	U	9.4
Fluorene	9.4	U	9.4
Hexachlorobenzene	9.4	U	9.4
Hexachlorobutadiene	9.4	U	9.4
Hexachlorocyclopentadiene	9.4	U	9.4
Hexachloroethane	9.4	U	9.4
Hexachlorophene	4700	U	4700
Hexachloropropene	9.4	U	9.4
Indeno[1,2,3-cd]pyrene	9.4	U	9.4
Isophorone	9.4	U	9.4
Isosafrole	9.4	U	9.4
Methapyrilene	1900	U	1900
3-Methylcholanthrene	9.4	U	9.4
Methyl methanesulfonate	9.4	U	9.4
2-Methylnaphthalene	9.4	U	9.4
Methyl parathion	9.4	U	9.4
2-Methylphenol	9.4	U	9.4
3 & 4 Methylphenol	9.4	U	9.4
Naphthalene	9.4	U	9.4
1,4-Naphthoquinone	9.4	U	9.4
1-Naphthylamine	9.4	U	9.4
2-Naphthylamine	9.4	U	9.4
3-Nitroaniline	47	U	47
2-Nitroaniline	120		47
4-Nitroaniline	47	U	47
Nitrobenzene	16		9.4
2-Nitrophenol	9.4	U	9.4
4-Nitrophenol	67		47
4-Nitroquinoline-1-oxide	19	U	19
N-Nitro-o-toluidine	9.4	U	9.4
N-Nitrosodiethylamine	9.4	U	9.4
N-Nitrosodimethylamine	9.4	U	9.4
N-Nitrosodi-n-butylamine	9.4	U	9.4
N-Nitrosodi-n-propylamine	9.4	U	9.4

Please see  
page 21

## Analytical Data

Client: Solutia Inc.

Job Number: 680-18197-1

Sdg Number: KPM002

Client Sample ID: PMA4S-0606

Lab Sample ID: 680-18197-2

Date Sampled: 06/30/2006 1200

Client Matrix: Water

Date Received: 07/06/2006 1310

### 8270C Semivolatile Compounds by Gas Chromatography/Mass Spectrometry (GC/MS)

Method: 8270C

Analysis Batch: 680-50150

Instrument ID: GC/MS SemiVolatiles - G

Preparation: 3520C

Prep Batch: 680-49310

Lab File ID: g4957.d

Dilution: 1.0

Initial Weight/Volume: 1060 mL

Date Analyzed: 07/17/2006 1950

Final Weight/Volume: 1 mL

Date Prepared: 07/07/2006 0832

Injection Volume:

Analyte	Result (ug/L)	Qualifier	RL
N-Nitrosodiphenylamine	9.4	U	9.4
n-Nitrosomethylethylamine	9.4	U	9.4
N-Nitrosomorpholine	9.4	U	9.4
N-Nitrosopiperidine	9.4	U	9.4
N-Nitrosopyrrolidine	9.4	U	9.4
o,o',o"-Triethylphosphorothioate	9.4	U	9.4
Parathion	9.4	U	9.4
p-Dimethylamino azobenzene	9.4	U	9.4
Pentachlorobenzene	32		9.4
Pentachloronitrobenzene	9.4	U	9.4
Pentachlorophenol	47	U	47
Phenacetin	9.4	U	9.4
Phenanthrene	9.4	U	9.4
Phenol	9.4	U	9.4
Phorate	9.4	U	9.4
2-Picoline	9.4	U	9.4
p-Phenylene diamine	1900	U	1900
Pronamide	9.4	U	9.4
Pyrene	9.4	U	9.4
Pyridine	47	U "e"	47
Safrole, Total	9.4	U	9.4
Sulfotepp	9.4	U	9.4
1,2,4,5-Tetrachlorobenzene	9.4	U	9.4
2,3,4,6-Tetrachlorophenol	9.4	U	9.4
Thionazin	9.4	U	9.4
2-Toluidine	9.4	U	9.4
1,2,4-Trichlorobenzene	2400	E	9.4
2,4,5-Trichlorophenol	9.4	U	9.4
2,4,6-Trichlorophenol	9.4	U	9.4
1,3,5-Trinitrobenzene	9.4	U	9.4
1-Chloro-3-nitrobenzene	9.4	U	9.4
1-Chloro-4-nitrobenzene	15		9.4
1-Chloro-2-nitrobenzene	15		9.4
2-Nitrobiphenyl	9.4	U	9.4
2,4-Dichloronitrobenzene	9.4	U	9.4
3-Nitrobiphenyl	9.4	U	9.4
3,4-Dichloronitrobenzene	9.4	U	9.4
4-Nitrobiphenyl	9.4	U	9.4

Surrogate	%Rec	Acceptance Limits
2-Fluorobiphenyl	94	59 - 103
2-Fluorophenol	81	56 - 100
Nitrobenzene-d5	88	60 - 102
Phenol-d5	95	55 - 104

## Analytical Data

Client: Solutia Inc.

Job Number: 680-18197-1

Sdg Number: KPM002

Client Sample ID: PMA4S-0606

Lab Sample ID: 680-18197-2

Date Sampled: 06/30/2006 1200

Client Matrix: Water

Date Received: 07/06/2006 1310

### 8270C Semivolatile Compounds by Gas Chromatography/Mass Spectrometry (GC/MS)

Method: 8270C

Analysis Batch: 680-50150

Instrument ID: GC/MS SemiVolatiles - G

Preparation: 3520C

Prep Batch: 680-49310

Lab File ID: g4957.d

Dilution: 1.0

Initial Weight/Volume: 1060 mL

Date Analyzed: 07/17/2006 1950

Final Weight/Volume: 1 mL

Date Prepared: 07/07/2006 0832

Injection Volume:

Surrogate	%Rec	Acceptance Limits
Terphenyl-d14	68	10 - 154
2,4,6-Tribromophenol	122	55 - 126

\* Please see  
pages 15,16,17  
for all data  
except 1,2,4 Trichlorobenzene

# **Analytical Data**

Client: Solutia Inc.

Job Number: 680-18197-1

Client Sample ID: PMA4S-0606

Sdg Number: KPM002

Lab Sample ID: 680-18197-2

Date Sampled: 06/30/2006 1200

Client Matrix: Water

Date Received: 07/06/2006 1310

## **8270C Semivolatile Compounds by Gas Chromatography/Mass Spectrometry (GC/MS)**

Method:	8270C	Analysis Batch:	680-50286	Instrument ID:	GC/MS SemiVolatiles - G
Preparation:	3520C	Prep Batch:	680-49310	Lab File ID:	g4980.d
Dilution:	40			Initial Weight/Volume:	.1060 mL
Date Analyzed:	07/18/2006 1440	Run Type:	DL	Final Weight/Volume:	1 mL
Date Prepared:	07/07/2006 0832			Injection Volume:	

Analyte	Result (ug/L)	Qualifier	RL
Acenaphthene	380	U	380
Acenaphthylene	380	U	380
Acetophenone	380	U	380
2-Acetylaminofluorene	380	U	380
alpha,alpha-Dimethyl phenethylamine	75000	U	75000
4-Aminobiphenyl	380	U	380
Aniline	750	U *	750
Anthracene	380	U	380
Aramite, Total	380	U	380
Benzo[a]anthracene	380	U	380
Benzo[a]pyrene	380	U	380
Benzo[b]fluoranthene	380	U	380
Benzo[g,h,i]perylene	380	U	380
Benzo[k]fluoranthene	380	U	380
Benzyl alcohol	380	U	380
1,1'-Biphenyl	380	U	380
Bis(2-chloroethoxy)methane	380	U	380
Bis(2-chloroethyl)ether	380	U	380
bis(chloroisopropyl) ether	380	U	380
Bis(2-ethylhexyl) phthalate	380	U	380
4-Bromophenyl phenyl ether	380	U	380
Butyl benzyl phthalate	380	U	380
4-Chloroaniline	750	U	750
4-Chloro-3-methylphenol	380	U	380
2-Chloronaphthalene	380	U	380
2-Chlorophenol	380	U	380
4-Chlorophenyl phenyl ether	380	U	380
Chrysene	380	U	380
Diallate	380	U	380
Dibenz(a,h)anthracene	380	U	380
Dibenzofuran	380	U	380
3,3'-Dichlorobenzidine	750	U	750
2,4-Dichlorophenol	380	U	380
2,6-Dichlorophenol	380	U	380
Diethyl phthalate	380	U	380
Dimethoate	380	U	380
7,12-Dimethylbenz(a)anthracene	380	U	380
3,3'-Dimethylbenzidine	750	U	750
2,4-Dimethylphenol	380	U	380
Dimethyl phthalate	380	U	380
Di-n-butyl phthalate	380	U	380
1,3-Dinitrobenzene	380	U	380
4,6-Dinitro-2-methylphenol	1900	U	1900

**Analytical Data**

Client: Solutia Inc.

Job Number: 680-18197-1

Sdg Number: KPM002

Client Sample ID: PMA4S-0606

Lab Sample ID: 680-18197-2

Date Sampled: 06/30/2006 1200

Client Matrix: Water

Date Received: 07/06/2006 1310

**8270C Semivolatile Compounds by Gas Chromatography/Mass Spectrometry (GC/MS)**

Method:	8270C	Analysis Batch:	680-50286	Instrument ID:	GC/MS SemiVolatiles - G
Preparation:	3520C	Prep Batch:	680-49310	Lab File ID:	g4980.d
Dilution:	40			Initial Weight/Volume:	1060 mL
Date Analyzed:	07/18/2006 1440	Run Type:	DL	Final Weight/Volume:	1 mL
Date Prepared:	07/07/2006 0832			Injection Volume:	

Analyte	Result (ug/L)	Qualifier	RL
2,4-Dinitrophenol	1900	U	1900
2,6-Dinitrotoluene	380	U	380
2,4-Dinitrotoluene	380	U	380
Di-n-octyl phthalate	380	U	380
Dinoseb	380	U	380
1,4-Dioxane	380	U	380
Disulfoton	380	U	380
Ethyl methanesulfonate	380	U	380
Famphur	380	U	380
Fluoranthene	380	U	380
Fluorene	380	U	380
Hexachlorobenzene	380	U	380
Hexachlorobutadiene	380	U	380
Hexachlorocyclopentadiene	380	U	380
Hexachloroethane	380	U	380
Hexachlorophene	190000	U	190000
Hexachloropropene	380	U	380
Indeno[1,2,3-cd]pyrene	380	U	380
Isophorone	380	U	380
Isosafrole	380	U	380
Methapyrilene	75000	U	75000
3-Methylcholanthrene	380	U	380
Methyl methanesulfonate	380	U	380
2-Methylnaphthalene	380	U	380
Methyl parathion	380	U	380
2-Methylphenol	380	U	380
3 & 4 Methylphenol	380	U	380
Naphthalene	380	U	380
1,4-Naphthoquinone	380	U	380
1-Naphthylamine	380	U	380
2-Naphthylamine	380	U	380
3-Nitroaniline	1900	U	1900
2-Nitroaniline	1900	U	1900
4-Nitroaniline	1900	U	1900
Nitrobenzene	380	U	380
4-Nitrophenol	1900	U	1900
2-Nitrophenol	380	U	380
4-Nitroquinoline-1-oxide	750	U	750
N-Nitro-o-toluidine	380	U	380
N-Nitrosodiethylamine	380	U	380
N-Nitrosodimethylamine	380	U	380
N-Nitrosodi-n-butylamine	380	U	380
N-Nitrosodi-n-propylamine	380	U	380

# Analytical Data

Client: Solutia Inc.

Job Number: 680-18197-1

Sdg Number: KPM002

Client Sample ID: PMA4S-0606

Lab Sample ID: 680-18197-2

Client Matrix: Water

Date Sampled: 06/30/2006 1200

Date Received: 07/06/2006 1310

## 8270C Semivolatile Compounds by Gas Chromatography/Mass Spectrometry (GC/MS)

Method: 8270C

Analysis Batch: 680-50286

Instrument ID: GC/MS SemiVolatiles -G

Preparation: 3520C

Prep Batch: 680-49310

Lab File ID: g4980.d

Dilution: 40

Initial Weight/Volume: 1060 mL

Date Analyzed: 07/18/2006 1440

Run Type: DL

Final Weight/Volume: 1 mL

Date Prepared: 07/07/2006 0832

Injection Volume:

Analyte	Result (ug/L)	Qualifier	RL
N-Nitrosodiphenylamine	380	U	380
n-Nitrosomethylethylamine	380	U	380
N-Nitrosomorpholine	380	U	380
N-Nitrosopiperidine	380	U	380
N-Nitrosopyrrolidine	380	U	380
o,o',o"-Triethylphosphorothioate	380	U	380
Parathion	380	U	380
p-Dimethylamino azobenzene	380	U	380
Pentachlorobenzene	380	U	380
Pentachloronitrobenzene	380	U	380
Pentachlorophenol	1900	U	1900
Phenacetin	380	U	380
Phenanthrene	380	U	380
Phenol	380	U	380
Phorate	380	U	380
2-Picoline	380	U	380
p-Phenylene diamine	75000	U	75000
Pronamide	380	U	380
Pyrene	380	U	380
Pyridine	1900	U	1900
Safrole, Total	380	U	380
Sulfotep	380	U	380
1,2,4,5-Tetrachlorobenzene	380	U	380
2,3,4,6-Tetrachlorophenol	380	U	380
Thionazin	380	U	380
2-Toluidine	380	U	380
1,2,4-Trichlorobenzene	6200	D	380
2,4,5-Trichlorophenol	380	U	380
2,4,6-Trichlorophenol	380	U	380
1,3,5-Trinitrobenzene	380	U	380
1-Chloro-3-nitrobenzene	380	U	380
1-Chloro-4-nitrobenzene	380	U	380
1-Chloro-2-nitrobenzene	380	U	380
2-Nitrobiphenyl	380	U	380
2,4-Dichloronitrobenzene	380	U	380
3-Nitrobiphenyl	380	U	380
3,4-Dichloronitrobenzene	380	U	380
4-Nitrobiphenyl	380	U	380

Surrogate	%Rec	Acceptance Limits
2-Fluorobiphenyl	0	59 - 103
2-Fluorophenol	0	56 - 100
Nitrobenzene-d5	0	60 - 102
Phenol-d5	0	55 - 104



## Analytical Data

Client: Solutia Inc.

Job Number: 680-18197-1

Sdg Number: KPM002

Client Sample ID: PMA4S-0606

Lab Sample ID: 680-18197-2

Client Matrix: Water

Date Sampled: 06/30/2006 1200

Date Received: 07/06/2006 1310

### 8270C Semivolatile Compounds by Gas Chromatography/Mass Spectrometry (GC/MS)

Method: 8270C

Analysis Batch: 680-50286

Instrument ID: GC/MS SemiVolatiles - G

Preparation: 3520C

Prep Batch: 680-49310

Lab File ID: g4980.d

Dilution: 40

Initial Weight/Volume: 1060 mL

Date Analyzed: 07/18/2006 1440

Run Type: DL

Final Weight/Volume: 1 mL

Date Prepared: 07/07/2006 0832

Injection Volume:

Surrogate	%Rec		Acceptance Limits
Terphenyl-d14	0	D	10 - 154
2,4,6-Tribromophenol	0	D	55 - 126

## DATA REPORTING QUALIFIERS

Client: Solutia Inc.

Job Number: 680-18197-1

Sdg Number: KPM002

Lab Section	Qualifier	Description
GC/MS VOA	U	Indicates the analyte was analyzed for but not detected.
	E	Result exceeded calibration range, secondary dilution required.
	D	Surrogate or matrix spike recoveries were not obtained because the extract was diluted for analysis; also compounds analyzed at a dilution will be flagged with a D.
GC/MS Semi VOA	U	Indicates the analyte was analyzed for but not detected.
	*	LCS or LCSD exceeds the control limits
	E	Result exceeded calibration range, secondary dilution required.
	D	Surrogate or matrix spike recoveries were not obtained because the extract was diluted for analysis; also compounds analyzed at a dilution will be flagged with a D.

## **SOLUTIA - 266**

Kenneth  
Bardo/R5/USEPA/US  
11/27/2006 02:16 PM

To crbran1@solutia.com  
cc  
bcc

Subject Quarter 2 Data

Craig - Here is our analysis of the 2nd quarter 2006 data for the Solutia plume stability monitoring program. If we have time, maybe we can discuss further at the 12/5 meeting. - Ken



Solutia 2 Quarter 2006 Plume Analysis.doc

November 27, 2006

**EPA Review of Plume Stability Monitoring Program, 2<sup>nd</sup> Quarter 2006, at the Solutia, WG Krummrich Facility, submitted October 20, 2006**

**Background:** EPA has completed a review of groundwater data for the second quarter 2006 at the Solutia facility located at Sauget, IL. This is the first quarter that all 17 plume stability monitoring well locations were sampled (see Figure 2) and a detailed potentiometric surface map for the DHU (see Figure 3) was constructed.

Concentrations of some site-related constituents (benzene, chlorobenzenes, chloroaniline, phenol, and PCB) are presented in Figures 4 and 5. However, no isoconcentration contour maps for VOCs and SVOCs are presented in the report to depict the contaminant plume. EPA requests that future reports present isoconcentration contour maps for constituents discussed below.

**Benzene:** The maximum concentration of benzene is 880,000 ppb in the SHU at the Former Chlorobenzene Storage Area. On-site concentrations of benzene in the DHU range from 580 to 3,900 ppb. The benzene plume in the DHU reaches the Mississippi River north of the Site R barrier wall in the vicinity of nested monitoring wells PSMW-15 and PSMW-16. Benzene concentrations in the DHU at the river range from 53 ppb (PSMW-16D) to 6,800 ppb (PSMW-15D). Benzene is not detected (< 1 ppb) at either location at the river in the MHU (PSMW-15M and PSMW-16M).

**Chlorobenzene:** The maximum concentration of chlorobenzene is 32,000 ppb in the DHU at the North Tank Farm, just downgradient of the Former Chlorobenzene Process Area. The chlorobenzene plume in the DHU reaches the Mississippi River along the entire length (4,400 ft.) of the monitoring zone (from PSMW-14D to PSMW-17). The actual boundaries of the chlorobenzene plume extend beyond the 4400 foot-long monitoring zone at the river. An additional well in the DHU should be considered north of monitoring well nest location PSMW-14. Chlorobenzene concentrations in the DHU at the river range from 920 to 2,300 ppb. Chlorobenzene concentrations in the MHU are non-detect (< 1 ppb) except at PSMW-16M where 21 ppb of chlorobenzene was detected.

**Total Dichlorobenzenes:** Maximum concentrations of total dichlorobenzenes (1,2-, 1-3, and 1-4-dichlorobenzene) are 33,200 ppb in the DHU at the Former Chlorobenzene Process Area. The dichlorobenzenes

plume in the DHU reaches the Mississippi River just north of the Site R barrier wall at nested monitoring wells PSMW-16. Maximum total dichlorobenzenes concentrations in the DHU at the river are 102 ppb. At PSMW-17, total dichlorobenzenes concentrations are 5,870 ppb. This area appears to be impacted by residual contamination outside the Site R barrier wall.

**Phenol:** Maximum concentrations of phenol are 170 ppb in the SHU at the Former Chlorobenzene Storage Area. The phenol plume in the DHU (although discontinuous) reaches the Mississippi River north of the Site R barrier wall at nested monitoring well PSMW-15. Maximum phenol concentrations in the DHU (PSMW-15D) are 140 ppb. Phenol is not detected (< 9.4 ppb) at the same location in the MHU (PSMW-15M).

**2-Chlorophenol:** Maximum concentrations of 2-chlorophenol are 96 ppb in the DHU at Lot F. The 2-chlorophenol plume in the DHU reaches the Mississippi River just north of the Site R barrier wall at nested monitoring well PSMW-16. Maximum 2-chlorophenol concentrations in the DHU (PSMW-16D) at the river are 17 ppb. 2-chlorophenol is not detected (< 9.4 ppb) at the same location in the MHU (PSMW-16M).

**p-Chloroaniline:** Maximum concentrations of p-chloroaniline are 370 ppb in the DHU at the Former Chlorobenzene Process Area. The p-chloroaniline plume in the DHU does not appear to reach the Mississippi River, stopping less than 1000-feet east of nested monitoring well PSMW-15. p-Chloroaniline is not detected (< 19 ppb) in the DHU (PSMW-15D) or at the same location in the MHU (PSMW-15M) at the river. At PSMW-17, p-chloroaniline concentrations are 7,600 ppb. This area appears to be impacted by residual contamination outside the Site R barrier wall.

**Total PCBs:** Maximum concentrations of total PCBs are 50 ppb in the DHU at the Former Chlorobenzene Process Area. Total PCBs are found at 27 ppb downgradient in the DHU at monitoring well PSMW-12D. Total PCBs are not detected (< 0.2 ppb) in the DHU at the Mississippi River at monitoring well PSMW-16D. The mono- to octachlorobiphenyl components of total PCBs are found on-site and the lesser chlorinated mono- to tetrachlorobiphenyl components of total PCBs are found downgradient near the river.

The October 2006 *PCB Mobility and Migration Investigation* reports that DNAPL is present in the SHU at the Former PCB Manufacturing Area. This area is located just upgradient of the Former Chlorobenzene Process Area. Maximum concentrations of total PCBs are 258 ppb in the SHU. The total PCBs present

in the SHU within the Former PCB Manufacturing Area are comprised of mono- to decachlorobiphenyls.

EPA recommends that further investigations be performed to better define the extent of the total PCB plume. For example, how far north of PSMW-12 are PCBs found and can the plume be discharging to the river between PSMW-15D and PSMW-16D. This is important to identify since the Illinois EPA TACO Tier 1 groundwater remediation objective for PCBs is very low (0.5 ppb). Concentrations near the river at PSMW-12 (27 ppb) are over 50 times greater the groundwater remediation objective. It would also be beneficial to determine if the PCB plume is being captured by the Site R barrier wall. Based on the potentiometric surface map, it appears that contaminants found in the vicinity of PSMW-12 could be partially captured by the Site R barrier wall.

**Miscellaneous:** Toluene, ethylbenzene, and xylenes are found on-site in the DHU at PSMW-1 and -2. Pentachlorophenol and 1,2,4-trichlorobenzene are found on-site in the DHU at PSMW-2 and PSMW-3. Naphthalene and 2-methylnaphthalene are found on-site in the DHU at PSMW-1 and PSMW-3, and in the SHU at PSMW-5.

A plume of vinyl chloride and 1,4-dioxane in the DHU extends to the river just north of the Site R barrier wall at nested well location PSMW-16. It is first noted in the DHU at PSMW-8. There are no other DHU wells upgradient to determine its origin. Maximum vinyl chloride concentrations are 35 ppb and maximum 1,4-dioxane concentrations are 52 ppb. Concentrations at the river are 13 and 14 ppb, respectively.

Isolated hits of pesticides are found in the DHU. gamma-BHC (0.6 ppb) and 4,4'-DDT (4.10 ppb) is found at PSMW-3, and heptachlor (0.37 ppb) is found at PSMW-12. Isolated hits of herbicides are found in the DHU. 2,4-D (0.58 ppb) is found at PSMW-8, and 2,4-D (4.20 ppb) and 2,4,5-T (1.5 ppb) are found at PSMW-17. Herbicides present at PSMW-17 appear to be related to residual contamination outside the Site R barrier wall.

**Potential Impacts on the Mississippi River:** On May 26, 2004, EPA made a determination that the migration of contaminated groundwater was under control at the Solutia facility. Although monitoring wells were not specifically located north of the Site R barrier wall along the Mississippi River, interpretation of plume boundary maps assumed VOCs were less than 10,000 ppb and SVOCs were in the hundred-ppb range. Therefore, concentrations generally exceeded 10 times the appropriate groundwater level (IEPA TACO



Tier 1 groundwater remediation objective). However, it was believed that the discharge was “acceptable” since VOCs and SVOCs were not detected in that area in surface water and sediment samples obtained near the riverbank in 2000 and 2002.

Based on second quarter 2006 data, the following groundwater contaminants discussed above exceed 10 times their appropriate groundwater level (IEPA TACO Tier 1 groundwater remediation objective) in the DHU at the river:

Groundwater Contaminant	Monitoring Well*	Concentration (ppb)	GW Remediation Objective (ppb)
Benzene	PSMW-15D	6,800	5
Benzene	PSMW-16D	53	5
Chlorobenzene	PSMW-14D	1,200	100
Chlorobenzene	PSMW-15D	1,300	100
Chlorobenzene	PSMW-16D	2,300	100

\* Does not include PSMW-17 due to possible local impacts from Site R.

As detailed in EPA’s May 26, 2004, determination that migration of contaminated groundwater was under control, no detectable concentrations of VOCs were detected in November 2000 in surface water and sediment 500-feet north of the Site R barrier wall at 50, 150, and 300-feet from the riverbank. This location would be midway between PSMW-15D and PSMW-16D. In November 2002, no VOCs were detected in surface water and sediment 1200 to 1900-feet north of the Site R barrier wall at 50, 150, and 300-feet from the riverbank. These locations would be from PSMW-15D to midway between PSMW-14D and PSMW-15D.

If VOC concentrations in the DHU in 2006 are assumed to be similar to those in 2000 and 2002, it would appear that the discharge of contaminated groundwater into the Mississippi River is “currently acceptable”. However, there is no certainty that contaminant concentrations in the DHU over time are the same. Additionally, the most contaminated zone identified at the Solutia facility plume discharge area to the river is the DHU, not the MHU. It is believed that contaminants from the MHU directly discharge to the river bottom approximately 150’ from shore. This is evident in the Conceptual Site Model provided in Section 3 of Volume I of the CMS Report. Figure 3.2 shows that the MHU aquifer intercepts the river just west of the riverbank and that it underlies the entire width of the river bottom. The DHU does not intercept the river, but lies 10 to 20-feet below the river bottom. Contaminated groundwater in the DHU would be expected to upwell into the base of the

river. However, the distance from the riverbank or area that contaminants from the DHU discharge to the river is less understood.

**Recommendation:** The discharge of high benzene concentrations centered at PSMW-15D and the high chlorobenzene concentrations centered at PSMW-16D can not be determined to be "currently acceptable" with any certainty at this time. Data is necessary to determine if the DHU discharges within 300-feet of the riverbank (the area that sediment and surface water was previously sampled). EPA recommends that the discharge location for the DHU north of the Site R barrier wall be characterized and that river sediments and surface water be sampled in that area for benzene and chlorobenzene. If concentrations of benzene and chlorobenzene are significant, surface water and sediment toxicity should be assessed to determine if the discharges of contaminated groundwater are "currently acceptable".

**SOLUTIA - 267**





*Solutions for a better life.*

December 15, 2006

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RECEIVED  
DEC 18 2006

**Re: Solutia Inc. – W. G. Krummrich Plant**

DIVISION FRONT OFFICE  
Waste, Pesticides & Toxics Division  
U.S. EPA - REGION 5

Dear Ms. Guerriero:

I am writing to thank you for your time on October 26<sup>th</sup> to discuss remediation efforts at the W.G. Krummrich plant. I understand that Craig Branchfield, Solutia's Project Manager and your team are making progress in the evaluation of potential interim and final corrective measures at the plant. Specifically, initial risk assessment information has been developed and shared with EPA, final technical issues are being addressed that will soon allow commencement of a Enhanced Aerobic Bioremediation pilot test, and we are collectively exploring opportunities for using the remaining ten thousand cubic yards of space in the Sauget Area 1 Disposal Cell to support potential remedial activities in the former PCB manufacturing area and/or other areas of the plant.

I also wanted to send you the attached article from today's *St. Louis Post Dispatch* about the exciting progress we continue to make to redevelop the Krummrich plant. As we briefly discussed during our meeting, Solutia is working with others to develop a Southern Illinois Green Energy Park on and around the plant that will include biodiesel, ethanol, and energy reclamation businesses, in addition to the ethanol facility currently under construction on property formerly owned by Solutia. We are very excited about these opportunities and continue to pursue them aggressively. During this transformation we will continue to work closely with your team to ensure that remediation proceeds in a way that is compatible with and supportive of future site redevelopment.

If you find yourself in the St. Louis area and would like to learn more about the redevelopment of the Krummrich plant I would be happy to meet with you and give you a personal tour. It is truly a great story in the making! In the meantime if you have any questions please feel free to contact me any time at (314) 674-2550 or e-mail me at [mwmcco@solutia.com](mailto:mwmcco@solutia.com).

Sincerely,

*Max W. McCombs*

Max W. McCombs  
Vice President, Environmental Safety and Health  
Solutia Inc.





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## Transforming Sauget eyesore into biofuel plant

*By Rachel Melcer*

ST. LOUIS POST-DISPATCH

Friday, Dec. 15 2006

The parking lots, rusted tanks and idle equipment of a century-old Sauget chemical plant will be transformed into a haven for biofuel production, say officials at Solutia Inc., its owner.

The Town and Country-based chemical company hopes to redeem a checkered environmental past at the W.G. Krummrich plant — and develop a model that it can replicate at five other old industrial plants across the country, plus one abroad.

Solutia, created in 1997 from the chemical assets of the old Monsanto Co., owns a lot of ugly, but useful industrial sites.

Lines idled by low-cost labor and stiff competition overseas can be remade for production of ethanol and biodiesel, say company executives. Some of Solutia's expert chemists can turn their attention to improving biofuel production processes, offering consulting services to other firms and perhaps devising related chemical products for Solutia to make.

In the end, the company could help produce fuel from corn and soybeans to reduce America's dependence on foreign oil, said spokesman Dan Jenkins.

The environmental benefits would be two-fold: Cars burning biofuels, rather than petroleum-based products, emit fewer ozone-forming pollutants. And industrial sites — complete with emergency response teams, utility hookups, sewer service and other vital infrastructure — offer a land-saving alternative to plowing under farm fields to build new biofuel plants, Solutia said.

It also is cheaper, providing ethanol plant operators with a cost savings of up to 25 percent over building from scratch in a rural area, said Art Huggard, director of Solutia's Entrepreneurial Growth Business. His unit is charged with finding rapidly expanding businesses for Solutia to pursue, such as the boom in biofuel.

"We've got things that work very well in our chemical business that we think will transfer very well" to making ethanol and biodiesel, he said. Solutia doesn't want to become a biofuel company — but it hopes to provide that industry with sites, consulting support and management to them.

Solutia also has chemical products that biofuel makers can employ, Huggard said. Solutia's Therminol heat-transfer fluid is being used at a biodiesel plant in Iowa to improve production consistency and quality, he said. Together with the National Corn-to-Ethanol Research Center at Southern Illinois University Edwardsville, Solutia is developing a chemical cleaner for ethanol production tanks that can limit equipment down time and improve efficiency.

The Krummrich plant has about 160 workers. Employment there peaked at 2,000 in the 1960s, when products included phosphoric and sulfuric acids, oil additives and polychlorinated biphenyls, or PCBs. The original site had 311 acres and Solutia owns 254 today, with operations on 80 acres.



In Sauget, Solutia is forging a Southern Illinois Green Energy Park in several ways:

- It sold 57 acres to Center Ethanol Co. LLC, which is building a \$100 million ethanol plant due to open in a year. Solutia and Validus, a local consulting firm, helped Center to win \$5.7 million in grants and incentives from the Illinois Department of Commerce and Economic Opportunity.
- With an \$800,000 grant from the Illinois Department of Agriculture, and a biodiesel company partner, Solutia is studying the feasibility of converting an idle chlorobenzene line to soy-based biodiesel production. Results are expected by March.
- Two sites, including a parking lot, are being considered as locations for biofuel projects that Solutia would not yet disclose.
- It would create an energy reclamation project, where excess energy produced in one operation is used to power another.
- Vacant laboratory space may be leased to biofuel firms for quality control, process development and other research.

"This site is nothing but opportunity," said Greta Senn, an engineer who became Krummrich plant manager a year ago. "We think the timing is right to be that catalyst to bring biofuels to Sauget."

In addition to chemical-handling experience and industrial infrastructure, the Krummrich site offers transportation options vital to a biofuel operation, Huggard said. Raw materials and tanks of fuel can travel by truck on nearby interstates, or on rail tracks running through the site. A dock on the Mississippi River gives access to barges; an underground pipeline can be used to pump fuel from production lines to tanks at the dock.

"This site provides transportation flexibility that's pretty unprecedented as far as ethanol sites we've seen or know about anywhere in the country," said Barry Frazier, president of Center Ethanol.

Missouri and Illinois also are thirsty for biofuels, with state regulations calling for their use. Rather than building a plant among corn fields — the most common and, therefore, more competitive approach — Center chose to locate where there is demand, Frazier said.

Much of the nation's harvest moves through the Port of St. Louis bound for export. Center will buy its supply alongside grain elevators, crushers and other local operations.

Frazier said Solutia's plan for a green energy park also was attractive. Some of Center's ethanol could be used to fuel an adjacent biodiesel production. An energy reclamation project could lower operating costs.

"It wasn't a major factor in deciding to locate here, but it was a positive to realize that nearby there may be some enhancements to the economics of our projects that we (can) participate in," Frazier said.

Solutia also aims to offer a competitive advantage for biofuel makers with its consulting arm. Chemists with decades of manufacturing experience should prove helpful to scientists in a relatively new and pioneering field, Huggard said.

Solutia will offer services including profitability assessments and improvement programs; design, engineering, safety and process control help for specific projects; and operations management for production at the Krummrich site.

These could make a difference as more biofuel plants come on line to meet political and economic demand, Huggard said. Solutia also offers quality control certifications needed for export, and experience in implementing Occupational Safety and Health Administration standards — which are just

reaching the ethanol industry.

Ethanol experts such as John Caupert, director of the research center at Southern Illinois University Edwardsville, expect ethanol will reach commodity status. At that point, added efficiency, quality control and the ability to be flexible in reaching various markets will be vital to ethanol plants.

"This area needs some green energy and needs some good jobs," Huggard said of Sauget. "Our goal is to have the plants that are running 10, 15, 20 years from now and have weathered the [markets] ups and downs."

Kathy Andria, president of the American Bottom Conservancy, a local environmental group, said she supports Solutia's approach. So long as biofuel plants are built to efficiently use resources such as water, and have low emissions — which will be the case at the natural gas-powered Krummrich site — she sees them as an improvement over chemical production.

Andria also approves of Solutia's plan to use an old industrial site, known as a brownfield, for a greener purpose. "I'm all for using the brownfields in the area, and I'm glad they're doing that," she said. "I would much rather see an ethanol plant in a brownfield than (in) a farm field."

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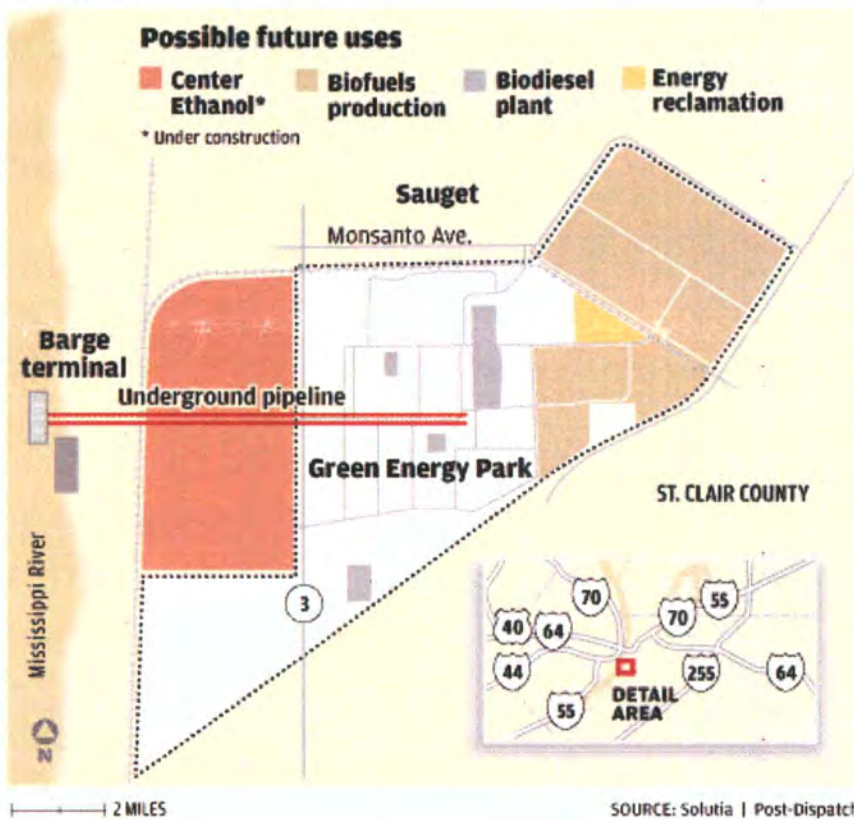
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## Green Energy Park

The 100-year-old W.G. Krummrich chemical plant in Sauget, owned by Solutia Inc., is being transformed into a site for making biofuels. Center Ethanol Co. is building an ethanol plant and Solutia may use idle equipment to make biodiesel. Two other biofuel projects are being studied, along with an option to re-use energy from the site to fuel its operations.



**SOLUTIA - 269**

**TECHNOLOGY SELECTION REPORT**

**FOR**

**SOLUTIA, INC. W.G. KRUMMRICH FACILITY  
SAUGET, ILLINOIS**

**IN SUPPORT OF  
U.S. ENVIRONMENTAL PROTECTION AGENCY REGION 5**

**UNDER  
RCRA ENFORCEMENT, PERMITTING, AND ASSISTANCE (REPA3)  
ZONE 2-REGION 5**

**DOCUMENT CONTROL NUMBER  
REPA3-3502-280v1**

**REVISION NO. 1  
EFFECTIVE DATE: January 15, 2007**



**TECHNOLOGY SELECTION REPORT  
FOR  
SOLUTIA, INC. W.G. KRUMMRICH FACILITY  
SAUGET, ILLINOIS**

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- Appendix B Technology Evaluation for the Former PCBs Manufacturing Area
- Appendix C Technology Evaluation for the Former Chlorobenzene Process Area
- Appendix D Corrective Measures Cost Estimate Detail Sheets

**ACRONYM LIST**

ags	Above ground surface
ANPR	Advanced Notice of Public Rulemaking
APC	Air pollution control
AOC	Area of concern
AST	Aboveground storage tank
BAP	Benzo(a)pyrene
bgs	Below ground surface
CALM	Cleanup Levels for Missouri
CBA	Chlorobenzoic acids
CDF	Confined Disposal Facility
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CKD	Cement kiln dust
CMO	Corrective measures objective
CMP	Corrective Measures Proposal
CMS	Corrective Measures Study
DCA	Dichloroethane
DCB	Dichlorobenzene
DCE	Dichloroethene
DHU	Deep Hydrogeologic Unit
DNAPL	Dense, non-aqueous phase liquid
DO	Dissolved oxygen
DOE	Department of Energy
DNT	Dinitrotoluene
DRE	Destruction and removal efficiency
EABR	Enhanced aerobic bioremediation
EPA	U.S. Environmental Protection Agency
ESL	Ecological Screening Level
FRTR	Federal Remediation Technologies Roundtable
FSP	Field sampling plan
GE	General Electric
GM	General Motors
GMCS	Groundwater Migration Control System
gpm	Gallons per minute
HAP	Hazardous air pollutant
HCl	Hydrochloric acid
HDPE	High-density polyethylene
HSWA	Hazardous and Solid Waste Amendments
HWMU	Hazardous waste management unit
IAC	Illinois Administrative Code
IEPA	Illinois Environmental Protection Agency
ISCO	In-situ chemical oxidation
ISTD	In-situ thermal desorption



ITRC	Interstate Technology and Research Council
LDR	Land disposal restrictions
LNAPL	Light, non-aqueous phase liquid
LTTD	Low-temperature thermal desorption
MBK	Methyl butyl ketone
MCB	Monochlorobenzene
MCL	Maximum Contaminant Level
MCLG	Maximum Contaminant Level Goal
MEK	Methyl ethyl ketone
MHU	Middle Hydrogeologic Unit
MIBK	Methyl isobutyl ketone
MNA	Monitored natural attenuation
MPE	Multi-phase extraction
MSL	Mean sea level
NAS	Naval Air Station
NASA	National Aeronautics and Space Administration
NAVD	North American Vertical Datum
ND	Non-detectable
O&M	Operations and maintenance
OMC	Outboard Marine Corporation
OPPTS	EPA Office of Pollution Prevention and Toxic Substances
ORP	Oxidation-reduction potential
OSHA	Occupational Safety and Health Administration
OSWER	Office of Solid Waste and Emergency Response
OU	Operable Unit
PAH	Polycyclic aromatic hydrocarbon
PCB	Polychlorinated biphenyl
PCE	Tetrachloroethene
PCP	Pentachlorophenol
PEL	Permissible exposure limit
POTW	Publicly-owned treatment works
ppm	Parts per million
PRB	Permeable Reactive Barrier
PRG	Preliminary Remediation Goal
PRP	Potentially responsible party
PVC	Polyvinyl chloride
QAPP	Quality assurance project plan
RCRA	Resource Conservation and Recovery Act
REPA3	RCRA Enforcement, Permitting, and Assistance contract
RM	River Mile
ROD	Record of Decision
ROI	Radius of influence
RTQ-PCR	Real-time quantitative polymerase chain reaction
SA1	Sauget Area 1
SA2	Sauget Area 2
SHU	Shallow Hydrogeologic Unit

S/S	Stabilization/solidification
SVE	Soil vapor extraction
SVOC	Semi-volatile organic compound
SWMU	Solid waste management unit
TACO	Tiered Approach to Corrective Action Objectives
TCE	Trichloroethene
TCB	Trichlorobenzene
TCLP	Toxicity Characteristic Leaching Procedure
TEQ	Toxicity equivalent
TMB	Trimethylbenzene
TOC	Total organic carbon
TSCA	Toxic Substances Control Act
TTI	Terra-Therm, Inc.
UAO	Unilateral Administrative Order
UIC	Underground injection control
UNH	University of New Hampshire
USACE	U.S. Army Corps of Engineers
UTS	Universal treatment standard
UV	Ultraviolet
VOC	Volatile organic compound
WWTP	Wastewater treatment plant
ZVI	Zero-valent iron



## EXECUTIVE SUMMARY

### *Introduction*

Under the U.S. Environmental Protection Agency (EPA) Resource Conservation and Recovery Act (RCRA) Enforcement, Permitting, and Assistance (REPA3) Contract, Work Assignment R05802-3, Booz Allen Hamilton (Booz Allen) was tasked to prepare this Technology Selection Report (Report) for proposed corrective measures at the Solutia, Inc. (Solutia), W.G. Krummrich facility, located in Sauget, Illinois (facility). This Report specifically addresses corrective measures for the facility (EPA ID No. ILD000802702) and affected off-site properties, which are being addressed under EPA's RCRA corrective action program. Two Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) operable units (OUs), designated Sauget Area 1 (SA1) and Sauget Area 2 (SA2), are located in proximity to the facility. This Report does not address remedial investigations or remedial actions at SA1 or SA2. The approximate boundaries of the RCRA facility and the two CERCLA OUs are illustrated on Figure 1.1 of the Draft Corrective Measures Study (CMS) [Solutia, 2004a].

Corrective action is being conducted at the facility in accordance with the Administrative Order on Consent between EPA and Solutia, effective May 3, 2000 (Order) [EPA, 2000]. Pursuant to Article (5) of the Order, Solutia submitted the draft Corrective Measures Proposal (CMP) (which Solutia labeled a CMS) to EPA in August 2004. In accordance with Article (5)(b) of the Order, EPA responded by requesting additional information from Solutia necessary to approve the CMP. The additional information essentially belonged to three distinct categories [EPA, 2004a, 2004b, 2004c, 2005a, and 2005b]:

1. Additional investigations of the nature and extent of RCRA hazardous constituents<sup>1</sup> in specific areas of the facility
2. Bench-scale tests and pilot-scale tests for innovative technologies having the potential to remove or destroy dense, non-aqueous phase liquids (DNAPLs) in situ at two on-site areas of concern (AOCs): the Former Polychlorinated Biphenyls (PCBs) Manufacturing Area and the Former Chlorobenzene Process Area
3. Installation of plume stability monitoring wells and performance of at least eight quarterly groundwater sampling events.

As of the date of this Report, Solutia has completed the following activities:

- Completed supplemental soil investigations of the nature and extent of RCRA hazardous constituents at the following areas: (1) Lot F, (2) Former Chlor-Alkali

<sup>1</sup> For the purposes of this Report, "RCRA hazardous constituents" are those listed in Appendix VIII of 40 Code of Federal Regulations (CFR) 261 and/or those constituents for which EPA has enforcement authority under the Hazardous and Solid Waste Amendments of 1984 (HSWA).



Production Area, (3) North Central Plant Process Area (soil only), and (4) Former Coal Storage Area.

- Completed a supplemental investigation of groundwater quality at the Route 3 Drum Site (referred to in this Report as the “Former Lot F Drum Disposal Area”).
- Conducted bench-scale tests of innovative technologies for destruction and/or removal of DNAPLs, as follows:
  - In-situ thermal desorption (ISTD) technology for:
    - Vadose zone soils at the Former PCBs Manufacturing Area
    - Vadose zone soils at the Former Chlorobenzene Process Area
    - Saturated zone soils in the Shallow Hydrogeologic Unit (SHU) at the Former Chlorobenzene Process Area
  - Enhanced aerobic bioremediation (EABR) technology for:
    - Saturated zone soils in the SHU at the Former Chlorobenzene Process Area
    - Saturated zone soils in the Middle Hydrogeologic Unit (MHU) at the Former Chlorobenzene Process Area.
- Installed a total of 20 plume stability monitoring wells and conducted groundwater sampling events in March 2006 and June 2006.

However, to date Solutia has not agreed to conduct field pilot-scale studies of innovative technologies to address large quantities of DNAPLs in the vadose zone soils and in the SHU. Solutia has proposed to conduct a pilot test of the EABR technology in the MHU, which, while potentially useful, does not in EPA’s opinion adequately address the significant quantities of DNAPLs and high soil and groundwater concentrations of PCBs, monochlorobenzene (MCB), and dichlorobenzenes (DCBs) at the two major source areas (Former PCBs Manufacturing Area and Former Chlorobenzene Process Area). Furthermore, Solutia has not proposed corrective measures for other on-site areas of soil and groundwater contamination at the facility. Therefore, EPA has decided to, based on the information available to date (including the bench-scale studies), evaluate the technologies that seem most appropriate for final corrective measures to address RCRA hazardous constituents at the facility.

#### *AOCs and Technology Selection Process*

This Report addresses a total of 11 AOCs at the facility. The definitions of these AOCs are similar to the areas identified in the Solutia [2004a] CMS, but have been altered for convenience in certain situations (e.g., where additional sampling data suggested that an AOC was more extensive than initially realized). The AOCs do not necessarily correspond to solid waste management units (SWMUs) or hazardous waste management units (HWMUs) referenced in earlier documents in the facility’s Administrative Record, because the on-site contamination is better described (and corrective measures more easily selected) based on broader AOC definitions that more closely align with former



chemical manufacturing and waste handling activities at the facility. Table ES-1 summarizes the AOCs, primary RCRA hazardous constituents associated with each AOC, and whether DNAPLs are a significant concern at the AOC (Figure 3-1 shows the locations and approximate boundaries of the defined AOCs):

**Table ES-1: AOCs Included in Technology Selection Evaluation**

AOCs	Primary RCRA Hazardous Constituents	DNAPL Present in Significant Quantities?	Comments
Former PCBs Manufacturing Area	PCBs; Benzene; MCB; Tetrachloroethylene (PCE); 1,2,4-Trichlorobenzene (TCB); 3,3'-Dichlorobenzidene; p-Chloroaniline; DCBs	Yes	PCB DNAPLs were detected in the SHU and in the MHU, as deep as 60 feet below ground surface (ft bgs)
Former Chlorobenzene Process Area	MCB; DCBs; Benzene; 1,2,4-Trimethylbenzene (TMB); Pentachlorophenol (PCP); PCE; p-Chloroaniline; Di- and Tri-chlorophenols	Yes	Approximately 6,000 gallons of MCB were released in the central portion of this area during a spill event in January 2001
Former Chlor-Alkali Production Area	Benzene; MCB; 1,2-DCB; 2-Methylnaphthalene; PCE; Trichloroethene (TCE); Mercury	No	Various volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), and mercury are present in isolated "hot spots" in the vadose zone
Former Lot F Drum Disposal Area	2,4,6-Trichlorophenol; Nitrobenzene; PCP; p-Chloroaniline	No	Intact drums were excavated and removed in 1985; decomposed drums and contaminated soil remain; RCRA cap was constructed in 1987
Central Plant Process Area	Benzene; MCB; DCBs; PCBs; p-Chloroaniline; 2-Methylnaphthalene; Chloromethane; Arsenic; Lead	No	Vadose zone is contaminated by VOCs, SVOCs, PCBs, and metals; groundwater quality in the SHU has not been adequately evaluated
Former Chlorobenzene and Benzene Storage Area	Benzene; MCB; PCBs; 3,3-Dichlorobenzidene; 2,4,6-Trichlorophenol; PCP; p-Chloroaniline; Phenol	No, although benzene light, non-aqueous phase liquid (LNAPL) may be present	Former "Big Mo" benzene aboveground storage tank (AST) was located within this AOC; former Hazardous Waste Accumulation Area was also located within this AOC



Table ES-1: AOCs Included in Technology Selection Evaluation

AOCs	Primary RCRA Hazardous Constituents	DNAPL Present in Significant Quantities?	Comments
Former North Plant Process Area	2-Hexanone (Methyl Butyl Ketone [MBK]), Dichloropropenes, Arsenic, MCB, Benzo(a)pyrene (BAP)	No	Vadose zone in the center of this AOC is contaminated with VOCs; groundwater quality in the SHU has not been adequately evaluated
Former PCB Warehouse Area	PCBs, Benzene, MCB	No	Vadose zone soils east of the former warehouse are contaminated with PCBs, benzene, MCB, "total VOCs," and/or "total SVOCs" <sup>1</sup>
Dinitrotoluene (DNT) Contamination South of "G" Street	DNT	No	Monsanto (the former facility owner) manufactured munitions at the facility during World War II, although specific records of DNT production or use are not available
Lot F Pipeline Corridor	Benzene	No	A benzene pipeline connecting a Mississippi River dock and terminal with the facility ASTs ran beneath the northern portion of Lot F
MHU and DHU	Ethylbenzene; Naphthalene; Benzene; PCBs; MCB; DCBs; p-Chloroaniline; 1,2,4-TCB; 2-Chlorophenol; PCP; Phenol; Vinyl chloride	No, although DNAPL ganglia are present beneath the Former PCBs Manufacturing Area and Former Chlorobenzene Process Area	The MHU and DHU are sand and sand and gravel aquifers, respectively, with relatively high hydraulic conductivities, groundwater velocities, and transmissivities

## Notes:

1. Historical data were not available for specific VOCs and SVOCs in soil at this AOC; only total VOCs and total SVOCs data were available.

Overarching remedial goals were developed for the site based on reasonable future land use, and are presented in Section 2 of this Report. Section 3 of this Report contains the evaluation of corrective measures for each individual AOC at the facility. Additional evaluations of potential technologies for the two major DNAPL source areas (Former PCBs Manufacturing Area and Former Chlorobenzene Process Area) are presented in Appendices B and C. Potentially impacted environmental media include the following:



- On-site soil
- On-site groundwater in the SHU, MHU, Deep Hydrogeologic Unit (DHU), and/or Bedrock Aquifer
- Off-site groundwater in the above-referenced aquifers between the western facility boundary and the Mississippi River
- Sediment in the Mississippi River (if impacts to sediment can be correlated to releases at the facility)
- Surface water in the Mississippi River (if impacts to surface water can be correlated to releases at the facility)
- Indoor air on site (i.e., vapor intrusion into existing or proposed structures)
- Ambient air on site.

For each AOC, the following process for technology selection was followed:

- Assemble background information on the area (brief description, RCRA hazardous constituents, and environmental media of concern)
- Screen potentially feasible technologies and perform a more detailed evaluation where required, consistent with the Advanced Notice of Public Rulemaking (ANPR) for RCRA Corrective Action [EPA, 1996]
- Identify the recommended technology or technologies and provide rationale for the selection
- Outline any required actions for implementation (e.g., pre-design investigations, pilot tests).

#### *Technologies Selected and Estimated Costs for Corrective Measures*

Table ES-2 lists the recommended technologies based on the technology evaluation and the estimated corrective measures costs for each AOC. Two cost scenarios (Average/Most Probable and Maximum/Most Conservative) are presented for each AOC. All cost estimates are: (1) net present worth values; (2) include capital costs, annual operations and maintenance (O&M) costs, and monitoring costs; and (3) are based on an assumed annualized discount rate of five percent.



**Table ES-2: Technologies Selected for On-Site AOCs and Associated Corrective Measures  
Cost Estimates for the W.G. Krummrich Facility**

AOCs	Selected Technology or Technologies	Average/Most Probable Cost Estimate	Maximum/Most Conservative Cost Estimate
Former PCBs Manufacturing Area	ISTD	\$17,491,000	\$34,084,000
Former Chlorobenzene Process Area	ISTD	\$4,404,000	\$5,845,000
Former Chlor-Alkali Production Area	Excavation	\$176,000	\$291,000
Former Lot F Drum Disposal Area	Existing RCRA Cap, Monitored Natural Attenuation (MNA)	\$404,000	\$914,000
Central Plant Process Area	Soil Vapor Extraction (SVE), Excavation	\$985,000	\$2,393,000
Former Chlorobenzene and Benzene Storage Area	SVE, Excavation	\$884,000	\$2,266,000
North Plant Process Area	SVE	\$214,000	\$506,000
Former PCBs Warehouse Area	Excavation	\$42,000	\$71,000
MHU and DHU			
• Without SA2 Groundwater Migration Control System (GMCS) Costs	Existing GMCS <sup>2</sup> , MNA	\$4,551,000	\$8,622,000
• With SA2 GMCS Costs	Existing GMCS, MNA	\$59,953,000	\$84,717,000
<b>Totals (without Area 2 GMCS costs)</b>		<b>\$29,151,000</b>	<b>\$54,992,000</b>
<b>Totals (with Area 2 GMCS costs)</b>		<b>\$84,553,000</b>	<b>\$131,087,000</b>

For additional rationale supporting selection of these technologies, refer to Section 3 of this Report.

<sup>2</sup> The GMCS consists primarily of a slurry wall installed between SA2 Site R and the Mississippi River. Based on groundwater sampling performed to date, a portion of the plume of VOCs and SVOCs emanating from the Krummrich facility is intercepted by the GMCS, thus preventing that plume component from discharging into the river. The northern portion of the facility plume is currently not captured by the GMCS.



## 1.0 INTRODUCTION

Under the EPA REPA3 Contract, Work Assignment R05802-3, Booz Allen was tasked to prepare this Report for proposed corrective measures at the facility. This Report specifically addresses corrective measures for the facility (EPA ID No. ILD000802702) and surrounding properties, which are being addressed under EPA's RCRA corrective action program. In proximity to the facility are two CERCLA OUs, designated SA1 and SA2. This Report does not address remedial investigations or remedial actions at SA1 or SA2. The approximate boundaries of the RCRA facility and the two CERCLA OUs are illustrated on Figure 1.1 of the Draft CMS Report [Solutia, 2004a].

Corrective action is being conducted at the facility in accordance with the Order [EPA, 2000]. Pursuant to Article (5) of the Order, Solutia submitted the draft CMP (which Solutia labeled a CMS) to EPA in August 2004. In accordance with Article (5)(b) of the Order, EPA responded by requesting additional information from Solutia that was deemed necessary to approve the CMP. The additional information essentially belonged to three distinct categories [EPA, 2004a, 2004b, 2004c, 2005a, and 2005b]:

1. Additional investigations of the nature and extent of RCRA hazardous constituents in specific areas of the facility
2. Bench-scale tests and pilot-scale tests for innovative technologies having the potential to remove or destroy DNAPLs at two on-site AOCs: the Former PCBs Manufacturing Area and the Former Chlorobenzene Process Area
3. Installation of plume stability monitoring wells and performance of at least eight quarterly groundwater sampling events.

As of the date of this Report, Solutia has completed the following activities:

- Completed supplemental soil investigations of the nature and extent of RCRA hazardous constituents at the following areas: (1) Lot F; (2) Former Chlor-Alkali Production Area; (3) North Central Plant Process Area (soil only); and (4) Former Coal Storage Area
- Completed a supplemental investigation of groundwater quality at the Route 3 Drum Site
- Conducted bench-scale tests of innovative technologies for destruction and/or removal of DNAPL, as follows:
  - ISTD technology for:
    - Vadose zone soils at the Former PCBs Manufacturing Area
    - Vadose zone soils at the Former Chlorobenzene Process Area
    - Saturated zone soils in the SHU at the Former Chlorobenzene Process Area



- EABR technology for:
  - Saturated zone soils in the SHU at the Former Chlorobenzene Process Area
  - Saturated zone soils in the MHU at the Former Chlorobenzene Process Area.
- Installed a total of 20 plume stability monitoring wells and conducted groundwater sampling events in March and June 2006.

In August 2006, EPA requested that Booz Allen prepare a report evaluating potential remedial technologies for the Former PCBs Manufacturing Area and the Former Chlorobenzene Process Area (i.e., the two DNAPL source areas). EPA also requested that potential remedial technologies be evaluated for groundwater in the MHU and in the DHU, and at the other eight on-site AOCs listed in Table ES-1.

### 1.1 Report Organization

Any definition of potential corrective measures must be preceded by a clear statement of the corrective measures objectives (CMOs) the remedial program is intended to achieve. First, an understanding of the CMOs is critical for selecting an appropriate technology or technologies for each AOC. The CMOs are also required so that EPA and the owner/operator can evaluate the ongoing progress of the remediation program and determine when the selected measures may be downgraded or terminated. Therefore, a discussion of the general CMOs is provided in Section 2. Based on these goals, Solutia will need to propose specific corrective action objectives for each AOC, consistent with the Illinois Tiered Approach to Corrective Action Objectives (TACO) regulations and relevant EPA objectives (e.g., Toxic Substances Control Act [TSCA] regulations, EPA Region 9 Preliminary Remediation Goals [PRGs], and EPA Region 5 Ecological Screening Levels [ESLs]) for contaminants and/or media not addressed under TACO.

Section 3 of this Report contains the evaluation of corrective measures for each individual AOC at the facility. For the purpose of this Report, AOCs are those areas identified during the facility site investigations that require some sort of corrective measures to comply with RCRA regulations and policies and/or mitigate risks to human health and the environment, for one or more environmental media. Environmental media include the following:

- On-site soil
- On-site groundwater in the SHU, MHU, DHU, and/or Bedrock Aquifer
- Off-site groundwater in the above-referenced aquifers between the western facility boundary and the Mississippi River
- Sediment in the Mississippi River (if impacts to sediment can be correlated to releases at the facility)



- Surface water in the Mississippi River (if impacts to surface water can be correlated to releases at the facility)
- Indoor air on site (i.e., vapor intrusion into existing or proposed structures)
- Ambient air on site.

For each AOC, the following process was followed:

- Assemble and present background information on the area (brief description, RCRA hazardous constituents, and media of concern)
- Screen potentially feasible technologies and perform a more detailed evaluation where required, consistent with the ANPR for RCRA Corrective Action [EPA, 1996]
- Identify the recommended technology or technologies and provide rationale for the selection
- Outline any required actions for implementation (e.g., pre-design investigations, pilot tests).

The recommended technologies for each AOC are summarized in Section 4. A cost estimate for implementation of the recommended corrective measures is contained in Section 5.

The recommendations and other information in this Report were derived based on the extensive RCRA administrative record for this facility. References that were used in preparing this Report are cited throughout the Report, and a detailed bibliography is contained in Section 6. An overview of the site geology and hydrogeology is contained in Section 3.11.1 of this Report.



## 2.0 CORRECTIVE MEASURES OBJECTIVES

Specific CMOs (i.e., media cleanup standards and points of compliance) for each AOC at the facility must fulfill the following general goals:

- Return the site to, at a minimum, conditions that would permit industrial land use. This may include one or more of the following: (1) cleanup of all impacted media to risk-based standards for industrial properties (e.g., as specified in the Illinois TACO regulations); and/or (2) use of engineering and/or institutional controls to prevent exposures during the cleanup period, including those to site workers and construction workers. Engineering controls may include passive ventilation systems or vapor barriers to mitigate indoor air exposures due to vapor intrusion. All engineering and institutional controls will be required to satisfy applicable requirements specified in the TACO regulations.
- Stabilize and remove significant contaminant mass from the vadose zone and SHU such that threats to groundwater in the deeper units (MHU and DHU) under long-term equilibrium conditions are adequately mitigated. At a minimum, this should include the following: (1) no detectable separate-phase DNAPL in monitoring wells within and immediately surrounding the source areas; (2) no concentrations of RCRA hazardous constituents in groundwater above respective solubility limits; (3) no exceedances of any contaminant-specific soil saturation concentrations or combined soil contaminant loading exceeding the organic carbon fraction; and (4) concentrations of all RCRA hazardous constituents below risk-based remediation objectives for Class I groundwater in on-site and downgradient off-site monitoring wells completed in the MHU and DHU, for at least two consecutive years of monitoring.
- Restore the groundwater in the MHU and DHU on site and between the facility and downgradient Site R to maximum beneficial use after an acceptable remediation/management period. Maximum beneficial use does not need to assume drinking water standards due to the proximity of the Mississippi River and use of the river by surrounding municipalities for their potable water supplies. However, the MHU and DHU groundwater should be usable (at a minimum) for non-potable purposes such as industrial process water and wash water, non-contact cooling water, or other commercial and industrial uses.
- Prevent migration of RCRA hazardous constituents within the MHU and DHU into the Mississippi River north of the Site R GMCS at concentrations exceeding applicable human health and ecological risk-based surface water and sediment cleanup goals. The GMCS is described in Section 3.11.3 of this Report.
- Achieve applicable and relevant site cleanup criteria under the TSCA Mega Rule [EPA, 1999] at the Former PCBs Manufacturing Area and for PCBs detected at other on-site AOCs.

Table 2-1 contains a listing of the TACO Tier 1 remediation objectives and other preliminary criteria used to evaluate and select technologies in this Report. As discussed during the meeting with EPA on December 5, 2006, Solutia is in the process of conducting a human health risk assessment for the facility. Consistent with TACO, Solutia may propose risk-based Tier 2 and Tier 3 CMOs for on-site AOCs and/or engineering or institutional controls. EPA will evaluate the appropriateness of any proposed risk-based CMOs for mitigating long-term risks to human health and the environment. Regarding engineering and institutional controls, EPA foresees these may be applicable in less-contaminated portions of AOCs or at AOCs where the threat to on-site or off-site receptors is minimal. In areas where significant releases have occurred, EPA anticipates that active remediation will be required.



Table 2-1: Preliminary CMOs for Different Environmental Media Used to Select Technologies, W.G. Krummrich Facility

RCRA Hazardous Constituents <sup>a</sup>	Soil CMOs (mg/kg) <sup>b</sup>			Indoor Air CMOs (µg/m <sup>3</sup> ) <sup>c</sup>	Groundwater CMOs (µg/L) <sup>d</sup>	Mississippi River CMOs	
	Industrial-Commercial	Construction Worker	Migration to Groundwater			Sediment (µg/kg) <sup>e</sup>	Surface Water (µg/L) <sup>f</sup>
VOCs							
Benzene	1.6	2.2	0.03	3.1	5	142	5
MCB	210	1.3	1	60	100	291	47
PCE	20	28	0.06	8.1	5	990	5
Chloroform	0.54	0.76	0.6	1.1	0.2	121	140
1,2-DCB	560	310	17	200	600	294	14
1,3-DCB	NS	NS	NS	110	NS	1,315	38
1,4-DCB	17,000	340	2	800	75	318	9.4
Methylene chloride	24	34	0.02	52	5	159	5
Toluene	650	42	12	400	1,000	1,220	253
Ethylbenzene	400	58	13	22	700	175	14
Xylenes (total)	320	320	150	7,000	10,000	433	27
cis-1,2-Dichloroethene (DCE)	1,200	1,200	0.4	35	70	NS	70
TCE	8.9	12	0.06	0.22	5	654	100
Chloromethane	NS	NS	NS	24	NS	NS	NS
Acetone	100,000	100,000	16	350	700	9.9	1,700
4-Methyl-2-pentanone	NS	NS	NS	NS	NS	25.1	170
MBK	NS	NS	NS	NS	NS	58.2	99
1,3-dichloropropene (cis- and trans-)	2.1	0.39	0.004	6.1	1	NS	NS
Vinyl chloride	1.1	1,1	0.01	2.8	0.2	202	0.2

Table 2-1: Preliminary CMOs for Different Environmental Media Used to Select Technologies, W.G. Krummrich Facility

RCRA Hazardous Constituents <sup>a</sup>	Soil CMOs (mg/kg) <sup>b</sup>			Indoor Air CMOs (µg/m <sup>3</sup> ) <sup>c</sup>	Groundwater CMOs (µg/L) <sup>d</sup>	Mississippi River CMOs	
	Industrial-Commercial	Construction Worker	Migration to Groundwater			Sediment (µg/kg) <sup>e</sup>	Surface Water (µg/L) <sup>g</sup>
SVOCs							
Nitrobenzene	140	9.4	0.1	2	3.5	145	220
PCP	24	520	0.03	NS	1	23,000	1
1,2,4-TCB	3,200	920	5	200	70	5,062	30
3,3'-Dichlorobenzidene	13	280	0.007	NS	20	127	4.5
p-Chloroaniline	8,200	820	0.7	NS	28	146	232
2,4-Dichlorophenol	6,100	610	1	NS	21	81.7	11
2,4,6-Trichlorophenol	390	540	0.2	NS	10	208	4.9
BAP	0.8	17	8	NS	0.2	150	0.014
2-Nitrochlorobenzene	NS	NS	NS	NS	NS	NS	NS
3,4-Dichloronitrobenzene	NS	NS	NS	NS	NS	NS	NS
Carbazole	290	6,200	0.6	NS	NS	NS	NS
Benzo(a)anthracene	8	170	2	NS	0.13	108	0.025
4-Nitrochlorobenzene	NS	NS	NS	NS	NS	NS	NS
2-Chlorophenol	10,000	10,000	4	18	35	31.9	24
Dibenzofuran	NS	NS	NS	14	NS	449	4
Dibenzo(a,h)anthracene	0.8	17	2	NS	0.3	33	NS
Hexachlorobenzene	1.8	2.6	2	0.053	0.06	20	0.0003
1-Chloro-2,4-Dinitrobenzene	NS	NS	NS	NS	NS	NS	NS
Benzo(b)fluoranthene	78	1,700	49	0.12	0.18	10,400	9.07
3-Methylphenol/4-	NS	NS	NS	NS	NS	NS	NS
N-nitrosodiphenylamine	1,200	25,000	1	NS	3.2	NS	NS



Table 2-1: Preliminary CMOs for Different Environmental Media Used to Select Technologies, W.G. Krummrich Facility

RCRA Hazardous Constituents <sup>a</sup>	Soil CMOs (mg/kg) <sup>b</sup>			Indoor Air CMOs (µg/m <sup>3</sup> ) <sup>c</sup>	Groundwater CMOs (µg/L) <sup>d</sup>	Mississippi River CMOs	
	Industrial-Commercial	Construction Worker	Migration to Groundwater			Sediment (µg/kg) <sup>e</sup>	Surface Water (µg/L) <sup>g</sup>
2-Methylnaphthalene	NS	NS	NS	70	NS	20.2	330
Naphthalene	270	1.8	12	3	140	176	13
2,4-DNT	8.4	180	0.0008	NS	0.02	14.4	44
2,6-DNT	8.4	180	0.0007	NS	0.31	39.8	81
Phenol	1,000,000	120,000	100	NS	100	49.1	180
<i>Pesticides</i>							
Heptachlor	1	16	23	0.019	0.4	0.6	0.0038
Total PCBs	1 <sup>a</sup>	1 <sup>a</sup>	NS	NS	0.5	59.8	1.2 x 10 <sup>-4</sup>
Total Dioxins	NS	NS	NS	NS	NS	0.011	2.78 x 10 <sup>-7</sup>
<i>Metals</i>							
Mercury	610	61	0.002	0.3 <sup>h</sup>	2	174	0.0013
Arsenic	1,200	61	0.05	NS	10 <sup>i</sup>	9,790	10
Lead	400	400	0.0075	NS	7.5	35,800	1.17

## Notes:

- List is based on RCRA hazardous constituents that have been detected above a potentially applicable site screening level. List may be expanded or reduced based on additional site characterization and risk assessment data.
- From Appendix B, Table B of the Illinois TACO regulations (35 Illinois Administrative Code [IAC] 742). The CMO presented is the lower (more conservative) value based on either the ingestion or inhalation exposure routes. For compounds with no TACO CMOs, EPA Region 9 PRGs are listed.
- From EPA Office of Solid Waste and Emergency Response's (OSWER's) *Draft Guidance for Evaluating the Vapor Intrusion Pathway to Indoor Air Pathway from Groundwater and Soils*, EPA 530-D-02-004, November 2002, Table 2b (target cancer risk of 10<sup>-5</sup> and hazard quotient ≤ 1).



- d. From Appendix B, Table E of the Illinois TACO regulations. The CMOs presented are based on Class I groundwater. From the available information, the MHU and DHU would be considered Class I groundwater. If Solutia wishes to use Class II groundwater CMOs for the SHU, the facility will need to prepare and submit the required justification request to the Illinois EPA pursuant to 35 IAC 620.
- e. From EPA Region 5's *Ecological Screening Levels*, August 22, 2003.
- f. Surface water CMOs are the lower of either the EPA Region 5 ESL or the Federal Maximum Contaminant Level (MCL) or Maximum Contaminant Level Goal (MCLG) for the contaminant in question.
- g. For total PCBs, the Illinois Environmental Protection Agency (IEPA) allows development of Tier 3 risk-based CMOs, provided that the CMOs conform with applicable provisions of the TSCA Mega Rule (40 CFR 761).
- h. CMO is for elemental mercury.
- i. The TACO regulations list the Class I groundwater CMO for arsenic as 50 µg/L. On January 22, 2001 EPA lowered the Federal MCL to 10 µg/L, which is the CMO listed in this table.

mg – Milligram

kg – kilogram

µg – Micrograms

m<sup>3</sup> – Cubic meters

L – Liters

NS – No standard listed in the source regulations. A site-specific CMO must be derived, if possible, using accepted risk assessment guidelines. For the indoor air pathway, no standard may be listed if: (1) toxicity data is insufficient or inconclusive, or (2) the compound is not volatile under normal ambient conditions.

### 3.0 CORRECTIVE MEASURES EVALUATION

This section presents the corrective measures evaluation for each AOC. Figure 3-1 is a site plan showing the locations and approximate boundaries of the AOCs. Where appropriate, tables are used to simplify the data presentation and clarify key elements and results. As discussed in Section 3.11, the unconsolidated deposits at the facility are classified into four major geologic units (from ground surface down): vadose zone, SHU, MHU, and DHU. Based on the facility conceptual site model presented in Solutia [2004a], the probable fate and transport pathways for RCRA hazardous constituents, and the likely application of recommended corrective measures, it was decided that vadose zone soils and the SHU would be discussed individually for each AOC. In general, corrective measures for the MHU and DHU are discussed on a site-wide basis and also include consideration of advective transport of RCRA hazardous constituents in these aquifers onto off-site properties and at the aquifer's probable discharge points into the Mississippi River.

Each of the potential technologies were evaluated using the criteria are contained in the ANPR [EPA, 1996], which are organized into threshold criteria and balancing criteria. The four threshold criteria are fundamental criteria that must be satisfied in order to utilize a particular technology or alternative, and consist of the following:

- Be protective of human health and the environment
- Attain media cleanup standards
- Control the source(s) of releases so as to reduce or eliminate, to the extent practicable, further releases of hazardous waste (including hazardous constituents) that might pose threats to human health and the environment
- Comply with applicable standards for waste management.

The five balancing criteria are next used to compare and contrast technologies that meet the threshold criteria, and they consist of the following:

- Long-term reliability and effectiveness
- Reduction of toxicity, mobility, and volume of wastes
- Short-term effectiveness
- Implementability
- Cost.

#### 3.1 Former PCBs Manufacturing Area – Vadose Zone, SHU, and MHU

##### 3.1.1 Description

The Former PCBs Manufacturing Area is located in the northwest corner of the facility property, south of Lot A and the railroad tracks. It encompasses approximately four acres



and is currently inactive. According to Solutia representatives, PCBs were manufactured at this AOC during the 1970s [Yare and Smith, 2004].

The near-surface materials beneath the Former PCBs Manufacturing Area consist of fill within the upper four to five feet of soil (as much as nine feet in the vicinity of boring PMA-S-3). The fill is underlain by several feet of clay and clayey sand, transitioning into predominantly sand with clay lenses at approximately 12 ft bgs to 13 ft bgs. Based on static water level measurements from monitoring well PSMW-2 (part of the Plume Stability Monitoring Well Network) in March 2006 and available boring logs, the water table is present at approximately 19 ft bgs at this AOC. The SHU extends from 19 ft bgs to approximately 40 ft bgs at this AOC. The MHU/DHU is present in predominantly sand and gravel deposits beginning between 30 ft bgs and 35 ft bgs, down to the bedrock surface at approximately 110 ft bgs; the final five feet above the bedrock surface are characterized as gravel with cobbles [Solutia, 2004a and 2006a].

Because the PCB DNAPLs detected in the MHU at the Former PCBs Manufacturing Area must be addressed pursuant to TSCA and RCRA requirements, the discussion of this AOC includes DNAPLs in the MHU.

### **3.1.2 Site Investigation Results**

#### **Soil**

Total PCBs (based on Aroclors™) have been detected in vadose zone soil in this area at concentrations up to 22,100 mg/kg (boring S025, located in the extreme eastern corner of this AOC). Nearly all sampling locations contained total PCBs at concentrations greater than 500 mg/kg, and many samples contained total PCBs above 1,000 mg/kg. Concentrations of greater than 1,000 mg/kg were detected throughout the vadose zone (i.e., from one ft bgs to two ft bgs down to 13 ft bgs to 14 ft bgs). A total of 21 soil samples analyzed in 2003 and 2004 exhibited total PCB concentrations above the selected screening standard (i.e., the Cleanup Levels for Missouri (CALM) default screening value of 18 mg/kg) [Solutia, 2004a].

During the Phase II PCBs Investigation in January and February 2006, Solutia conducted a direct-push investigation to demarcate the 25 mg/kg isocontour for total PCBs in soil. The 25 mg/kg threshold is the concentration above which corrective action is required under the TSCA Mega Rule for closure in place of PCBs-impacted soils at "low occupancy" properties as defined in the rule [EPA, 1999]. Immunoassay kits, supplemented by fixed-base laboratory analyses at several locations, were used to evaluate the sampling data. According to the soil sampling results, soils with concentrations above 25 mg/kg extend laterally beneath most of the Former PCBs Manufacturing Area and, in addition, extend out slightly to the south and west and also northeast beneath the railroad tracks toward Lot A [Solutia, 2006b].

During the Phase II PCBs Investigation, soil samples were analyzed for PCB homologs, rather than Aroclors™, to better characterize potential weathering in the subsurface



environment at the Former PCBs Manufacturing Area. In soil borings advanced and sampled between the ground surface and 20 ft bgs, total PCBs (i.e., sum of the homologs) were detected at up to 148.1 mg/kg (at boring PMA-BS-6-02-04). While all PCB homologs were detected in one or more samples, dichlorobiphenyl and hexachlorobiphenyl appeared to occur most frequently at concentrations above 10 mg/kg. The most impacted boring location (PMA-BS-6-02-04) contained 26 mg/kg of decachlorobiphenyl, 30 mg/kg of heptachlorobiphenyl, 51 mg/kg of hexachlorobiphenyl, 9.4 mg/kg of nonachlorobiphenyl, 12 mg/kg of octachlorobiphenyl, 18 mg/kg of pentachlorobiphenyl, and 1.7 mg/kg of tetrachlorobiphenyl.

Additional VOCs and SVOCs detected above TACO Tier 1 industrial soil remediation objectives at the Former PCBs Manufacturing Area include benzene; MCB; PCE; 1,2,4-TCB; and 3,3'-dichlorobenzidene [Solutia, 2004a]. Many of the exceedances were detected in shallow soil (two ft bgs to four ft bgs) at sampling location S0802.

### Groundwater

Solutia conducted vertical profile groundwater sampling, using direct-push equipment and temporary wells, during the February 2006 investigation at the Former PCBs Manufacturing Area. All four vertical profiling borings and almost all of the depth intervals sampled between 20 ft bgs and 60 ft bgs contained total PCBs above the TACO Tier 1 remediation objective of 0.5 µg/L for Class I groundwater. The highest concentrations were detected in boring GW-2 at 20 ft bgs (35,380 µg/L) and in boring GW-4 at 20 ft bgs (70,009 µg/L). Based on the boring logs, 20 ft bgs is within the silt and silty sand soils that comprise the SHU.

The detected PCBs concentrations predominantly belonged to the moderately and highly chlorine-substituted biphenyls (i.e., trichlorobiphenyl through octachlorobiphenyl). For example, in groundwater sample PMA-GW-4-20, homolog concentrations ranged from 69 µg/L to 1,400 µg/L for mono-, di-, nona-, and decachlorobiphenyls, but from 8,200 µg/L to 18,000 µg/L for trichlorobiphenyl through octachlorobiphenyl homologs [Solutia 2006c]. The 12 dioxin-like PCB congeners, which are among those of greatest potential toxicity to human or ecological receptors, primarily belong to the tetra-, penta-, and hexachlorobiphenyl homologs (one of the 12 is a heptachlorobiphenyl).

In early 2006, Solutia completed one monitoring well cluster inside the source zone (one new well and one previously existing well) and also installed three nested monitoring well clusters downgradient from the source zone at the Former PCBs Manufacturing Area. The purpose of these wells was to begin monitoring groundwater quality inside and downgradient from the PCBs-impacted zone. Each well cluster consists of:

- One monitoring well completed in the SHU, with a five-foot long screen. The top of screen ranges from 19.9 ft bgs at well PMAMW-1S to 22.4 ft bgs at well PMAMW-3S.



- One monitoring well completed in the MHU, also with a five-foot long screen. The top of screen ranged from 54.3 ft bgs at well PMAMW-1M to 68.55 ft bgs at well PSMW-2 (the previously-existing well inside the source zone).

These well clusters were sampled for the first time at the end of June 2006. A summary of the key results is presented in Table 3-1.

**Table 3-1: Key Results of June 2006 Sampling Event, Former PCBs Manufacturing Area**

Monitoring Well	Screened Interval (ft bgs)	RCRA Hazardous Constituents Exceeding TACO Standards	Detected Concentrations (µg/L)
PMA-1M	54.3 – 59.3	Benzene	2,500
		MCB	1,600
		p-Chloroaniline	70
PMA-2S	22.33 – 27.33	Chloroform	3.4
		Total PCBs*	2.1
PMA-2M	56.43 – 61.54	Benzene	4,400
		MCB	11,000
		p-Chloroaniline	150
PMA-3S	22.4 – 27.4	Total PCBs*	0.66
PMA-3M	56.81 – 61.81	1,4-DCB	600
		Benzene	1,600
		MCB	1,300
		p-Chloroaniline	120
		Total PCBs*	5.18
PMA-4S	20.33 – 25.33	1,4-DCB	3,400
		Benzene	16
		MCB	420
		p-Chloroaniline	59
		1,2,4-TCB	6,200
		Nitrobenzene	16
		Total PCBs*	256
PS-2	68.55 – 73.55	Benzene	3,700
		MCB	520
		p-Chloroaniline	48

\* Based on sampling and analysis data for the ten PCB homologs.

At monitoring well PMA-4S (inside the source area), the concentration of total PCBs was approximately 500 times the TACO cleanup standard for Class I groundwater. In



addition, all ten PCB homologs were detected in this groundwater sample, while in the other four samples in which PCBs were detected, only mono- and dichlorobiphenyl were present. The high concentrations detected in PMA-4S are likely related to the observation of a 0.73-foot thick layer of free-phase DNAPL in that same well [Solutia, 2006d].

### DNAPL

Many of the PCB homolog groundwater concentrations detected during the February 2006 vertical profiling sampling exceeded the solubility limit(s) of individual homologs (i.e., an indicator of potential DNAPL). The homolog data and solubility limits are presented in Appendix A of this report. This behavior was particularly noted at the 20 ft bgs depth, in borings PMA-GW-1, PMA-GW-2, and PMA-GW-4, with the majority of homologs exceeding their respective solubility limits by considerable margins. Lesser concentrations, but still above solubilities, were noted in boring PMA-GW-3 at the 30 ft bgs depth, boring PMA-GW-1 at the 40 ft bgs depth, and borings PMA-GW-1, PMA-GW-2, and PMA-GW-3 at the 50 ft bgs depth [Solutia, 2006b].

In addition, separate-phase DNAPL was observed in the temporary wells during the vertical profiling sampling. The measured thickness of DNAPL ranged from 0.09 feet at PMA-GW-2 (50 ft bgs) to 0.93 feet at PMA-GW-4 (30 ft bgs). DNAPL was measured in three of the four temporary well points installed at the 50 ft bgs depth, indicating that separate-phase PCBs have migrated vertically into the MHU. As mentioned above, free-phase DNAPL was also observed in permanent monitoring well PMA-4S during the June 2006 sampling event.

### Indoor Air

In March and September 2003, Solutia conducted sampling and analysis of indoor air at the Building CCB – East Shop, which is located within the Former PCBs Manufacturing Area. During the March 2003 sampling event, methylene chloride was detected above the EPA target concentration for the vapor intrusion exposure pathway (440 parts per billion by volume [ppbv] versus 150 ppbv) but below the Occupational Safety and Health Administration (OSHA) permissible exposure limit (PEL) of 25,000 ppbv. Solutia also collected soil vapor samples from boring SVP-7A, which is located near the northern boundary of the Former PCBs Manufacturing Area. The sampling interval was from 4.4 ft bgs to 4.9 ft bgs, which, based on boring logs, places it within a zone of silty or clayey fill material. Benzene; MCB; 1,2-DCB; and 1,4-DCB were all detected above the respective EPA target concentrations for the vapor intrusion pathway and below the respective OSHA PELs [Solutia, 2003]. EPA's current policy is that PELs are acceptable standards for evaluating conformance with the CA725 Environmental Indicator (EI), but risk-based concentration limits (e.g., the vapor intrusion standards) must be used to evaluate and select final corrective measures.



### 3.1.3 Bench-Scale Tests

In 2005, Solutia conducted a bench-scale treatability test of the ISTD technology on a soil sample from the unsaturated zone in the Former PCBs Manufacturing Area. The sample was collected in proximity to soil boring S0825 at a depth of 1.5 ft bgs, which prior investigations had indicated was the area with the greatest concentration of total PCBs. Three sub-cores of the original soil core were subjected to heating, at temperatures of 300 degrees Celsius (°C) (572 degrees Fahrenheit [°F]), 350 °C (662 °F), and 425 °C (797 °F), respectively, for a period of 72 hours. The purpose of this heating was to measure the amount of total PCBs mass removed from the sample via reduction in interfacial tension, viscosity increases, solubility enhancement, volatilization, steam stripping, chemical oxidation, and/or pyrolysis. The mass reduction in total PCBs was measured by analyzing sub-samples of soil from each of the three test cores before starting, and after completion of, each bench-scale test.

In-situ thermal conduction heating was simulated in the laboratory by placing the soil sub-cores within a metal cylinder and placing the entire cylinder inside an oven. The oven temperature was raised until the temperature inside the test cylinder (measured by a thermocouple inserted into the cylinder) reached the target temperature, at which time the 72-hour test began. In addition, a constant air stream was passed through the cylinder to simulate the vacuum extraction airflow typically used in field ISTD systems.

The mass reductions of PCB homologs resulting from the ISTD bench-scale treatability test are presented in Table 3-2.

**Table 3-2: ISTD Bench-Scale Treatability Test Results, Former PCBs Manufacturing Area**

PCB Homolog	Test Temperature		
	300 °C (572 °F)	350 °C (662 °F)	425 °C (797 °F)
Monochlorobiphenyl	NA <sup>1</sup>	NA <sup>1</sup>	NA <sup>1</sup>
Dichlorobiphenyl	99.86%	99.86%	99.994%
Trichlorobiphenyl	99.93%	99.93%	99.997%
Tetrachlorobiphenyl	99.98%	99.98%	99.999%
Pentachlorobiphenyl	99.95%	99.99%	99.999%
Hexachlorobiphenyl	99.86%	99.99%	99.999%
Heptachlorobiphenyl	99.72%	99.98%	99.999%
Octachlorobiphenyl	99.55%	99.96%	99.998%
Nonachlorobiphenyl	99.53%	99.70%	99.985%
Decachlorobiphenyl	98.32%	98.32%	99.955%
<b>Total PCBs</b>	<b>99.81%</b>	<b>99.96%</b>	<b>99.998%</b>

1. Not Applicable - Both the initial and final monochlorobiphenyl concentrations were below laboratory quantification limits.



At the lowest treatment temperature, 300 °C (572 °F), total PCBs were reduced from an initial concentration of 2,447 mg/kg to approximately 4.6 mg/kg, a removal efficiency of 99.8 percent [Solutia, 2006e].

### 3.1.4 Technology Evaluation

Because of the number of innovative and conventional technologies potentially applicable, a detailed technology evaluation was performed for vadose zone soil and the SHU at the Former PCBs Manufacturing Area (Appendix B). A total of five ex-situ technologies and six in-situ technologies were first screened to select the most promising candidate technologies. Based on the screening, the following four technologies were accepted for detailed evaluation against the ANPR threshold and balancing criteria:

- Excavation and off-site disposal
- Taciuk process
- Soil washing/solvent extraction
- ISTD.

Threshold Criteria: All four of the above technologies are considered capable of meeting the threshold criteria. All would increase protectiveness of human health and the environment by removing significant quantities of PCBs from the subsurface. All of the accepted technologies also have the capability to control the contaminant source and significantly reduce source mass, although ISTD is the only technology in this group that could practicably contain or remove PCB DNAPLs below the water table.

Balancing Criteria: All four technologies have been tested in the field in at least one full-scale application and have exhibited good long-term reliability and effectiveness, once startup and shakedown problems were overcome. All four technologies can achieve high reductions in toxicity, mobility, and/or volume of PCBs-contaminated source materials (e.g., 98 percent or greater mass reduction); however, only ISTD can effectively and practicably remove source mass below the water table, which is important considering that PCB DNAPLs have been detected as deep as 60 ft bgs at the AOC. Potential short-term impacts include (depending on the technology): (1) fugitive and/or stack air emissions of PCBs and other RCRA hazardous constituents; (2) emissions, traffic, and noise from diesel-powered trucks and equipment; (3) wastewater from scrubbers, condensate build-up, or cooling water; and/or (4) solid or hazardous wastes such as spent activated carbon and scrubber sludge. Implementability issues associated with one or more of the technologies include: (1) air quality permits; (2) on-site space for aboveground equipment and/or soil piles; (3) skilled field labor and technical support; and (4) for soil washing, a supply of commercial-grade propane or butane. In addition, the ISTD technology requires that a dense grid of heater and heater-vacuum wells be installed within the impacted zone. Costs for all alternatives are generally high (i.e., in the range of \$150 per cubic yard [ $\text{yd}^3$ ] to \$500 per  $\text{yd}^3$ ), but all except off-site disposal would benefit from economies of scale. Refer to Appendix B for a more extensive evaluation of the four technologies with respect to the specific ANPR balancing criteria.



### 3.1.5 *Recommended Technology and Rationale*

The recommended technology for the Former PCBs Manufacturing Area is ISTD, for the following reasons:

- The technology has been proven capable of achieving the types of mass and concentration reductions of total PCBs required to control and reduce source materials (including PCB DNAPLs) and to improve site groundwater quality in the long term. In addition to the data collected from full-scale applications at other sites, the bench-scale test on PCBs-contaminated soil from the Former PCBs Manufacturing Area resulted in over 99.8 percent mass removal. At five commercial-scale sites where ISTD has been implemented for remediation of PCBs, average mass removal efficiencies have ranged from 99.8 percent to 99.999 percent [Baker, et al, no date].
- As discussed in Appendix B, the time required to achieve significant mass and concentration reductions is relatively short compared to other available technologies (i.e., on the order of months rather than years).
- The ISTD technology is capable of treating soil above and below the water table and groundwater simultaneously. In addition, by raising the subsurface temperature to at least 780 °F to destroy or remove PCBs, all other VOCs and SVOCs detected in the Former PCBs Manufacturing Area will be destroyed or removed by volatilization, steam stripping, chemical oxidation, and/or pyrolysis.
- Remediation is performed in situ; no excavation or backfilling is involved. In addition, the amount of waste requiring off-site treatment is significantly less than in other alternatives, which reduces the project's dependence on a very limited number of distant and high-cost disposal facilities permitted under TSCA to accept PCBs-contaminated material.
- Based on the preliminary cost information, the costs associated with ISTD are in the same range, or slightly lower, than the other accepted technologies, primarily because the technology does not rely on off-site disposal of PCBs remediation wastes.

### 3.1.6 *Required Actions for Implementation*

The following actions are required prior to, or in the initial phase(s) of, implementing the recommended technology:

- A field pilot test should be conducted in the Former PCBs Manufacturing Area for the vadose zone, SHU, and MHU. The purposes of the field pilot test are to: (1) evaluate the effectiveness of the ISTD technology on saturated soils in the SHU; (2) evaluate whether ISTD could also extract or destroy PCB DNAPLs in the MHU (i.e., at depths of 60 ft bgs or greater); (3) determine additional latent energy requirements for boiling off groundwater within the SHU and MHU; (4) evaluate parameters for



scaling up the technology to the entire AOC such as well spacings, well depths, and air pollution control (APC) system requirements; (5) determine if dewatering practices or hydraulic controls are required within or at the upgradient boundary of the AOC (excessive groundwater influx could prevent the ISTD system from reaching the target temperature of 780 °F); (6) collect data required to prepare a final corrective action cost estimate; and (7) estimate the approximate duration of full-scale remediation activities required to achieve the site CMOs.

- The extent of dissolved-phase PCBs and PCB DNAPLs should be adequately characterized. At a minimum, this characterization should be based on sampling data using EPA Method 680 (PCB homologs). In addition to defining the lateral extent of total PCBs above 25 mg/kg, the vertical extent of PCB DNAPLs must be determined (i.e., samples must be collected beneath the 60 ft bgs depth where the DNAPLs were recently noted).

### **3.2 Former Chlorobenzene Process Area – Vadose Zone and SHU**

#### **3.2.1 Description**

The Former Chlorobenzene Process Area is located in the south-central portion of the facility. It encompasses approximately 13 acres and is currently inactive. This area was utilized for manufacturing MCB and DCBs from approximately 1926 through 2004 [Solutia, 2004a]. Numerous process tanks, overhead piping runs, and underground sewers are present in this area. A former rail car loading/unloading area is located directly east of and adjacent to the Former Chlorobenzene Process Area and will be considered part of the process area for the purpose of selecting corrective measures.

Numerous spills and releases of process chemicals occurred in this area, the most significant of which took place on January 7, 2001. On that date, approximately 10,000 gallons of MCB were released when a flush valve was left open, causing a catalyst addition hopper containing MCB to overflow. Further releases occurred when the product entered and chemically degraded the on-site process drain system beneath the chlorobenzene processing apparatus. Approximately 3,800 gallons of MCB were recovered, meaning that 6,200 gallons were released to on-site soil based on mass balance. In March and April 2001, a multi-phase extraction (MPE) system was installed as an interim measure to contain and remove MCB from the vadose zone and SHU. However, because the subsurface at the Former Chlorobenzene Process Area contains numerous voids and fractures,<sup>3</sup> it was not possible to apply sufficient vacuum for the MPE system to be effective, and only ten gallons of MCB were recovered in total. Another 100 gallons were recovered by reconfiguring the system to operate in a passive mode with low-flow, free product pumps [Solutia, 2004a].

<sup>3</sup> A portion of Dead Creek historically flowed north to south through this AOC. When the creek was filled in to construct the chlorobenzene process equipment, fractures and voids in the fill material apparently resulted due to the type of fill used and/or inadequate compaction.



The near-surface materials beneath the Former Chlorobenzene Process Area consist of a heterogeneous mixture of silt, sand, and gravel, with occasional thin clay layers, to depths of between 30 ft bgs and 40 ft bgs. Based on static water level measurements in monitoring well PSMW-3 (part of the Plume Stability Monitoring Well Network) in March 2006 and geologic cross-sections of the site [Solutia, 2004b], the SHU is present between 17 ft bgs and 35 to 40 ft bgs in this area. The MHU is present in predominantly sand deposits, beginning at between 35 ft bgs and 40 ft bgs and extending down to approximately 55 ft bgs. Sand and gravel with some cobbles (the DHU) are present from approximately 55 ft bgs to the top of limestone bedrock at approximately 110 ft bgs (the final five feet above the bedrock surface are characterized as gravel with cobbles) [Solutia, 2004a and 2006a].

### **3.2.2 Site Investigation Results**

#### Soil

During prior investigations in the Former Chlorobenzene Process Area, a total of 15 soil borings were advanced, and 53 soil samples were collected and analyzed, at depths ranging from one ft bgs to 110.5 ft bgs. The organic RCRA hazardous constituents detected above TACO Tier 1 corrective action objectives for industrial soil are listed in Table 3-3 below.

**Table 3-3: Organic RCRA Hazardous Constituents Detected in Soil at the Former Chlorobenzene Process Area**

RCRA Hazardous Constituents	Number of Exceedances	Maximum Detected Concentration (mg/kg)
MCB	38	2,300
1,4-DCB	26	4,200
1,2-DCB	19	9,200
Benzene	16	74
1,2,4-TCB	16	590
PCP	11	1,100
PCE	8	550
p-Chloroaniline	8	66
2,4-Dichlorophenol	7	95
2,4,6-Trichlorophenol	5	22
BAP	4	3.8
2-Nitrochlorobenzene	3	180
3,4-Dichloronitrobenzene	3	5,200
Carbazole	3	2
Benzo(a)anthracene	3	7.3
Toluene	2	100
4-Nitrochlorobenzene	2	53
2-Chlorophenol	2	12
Dibenzofuran	2	12
Nitrobenzene	2	880
Ethylbenzene	1	11,000
Xylenes (total)	1	44,000
Methylene chloride	1	0.73
cis-1,2-DCE	1	29
TCE	1	7.6
Dibenzo(a,h)anthracene	1	1.2
Hexachlorobenzene	1	23
1-Chloro-2,4-Dinitrobenzene	1	170
Benzo(b)fluoranthene	1	5.2
3-Methylphenol/4-	1	4.5
N-Nitrosodiphenylamine	1	10
Total PCBs	1	29.1
Total dioxin toxicity equivalent (TEQ)	1	0.06728



Furthermore, even though it does not have a TACO Tier 1 corrective action objective, 1,3-DCB was detected at elevated concentrations (i.e., greater than 10 mg/kg) in many of the borings. The zones with the greatest number of exceedances and/or highest magnitude of contaminant concentrations were: (1) the vadose zone, (2) the SHU, and (3) the DHU directly above the bedrock surface. The implications of these findings are discussed below in the discussion regarding DNAPLs. Moreover, low to moderate concentrations of benzene and MCB were detected throughout the soil column [Solutia, 2004a].

### Groundwater

No permanent monitoring wells screened in the SHU have been installed in the Former Chlorobenzene Process Area. However, monitoring well PSMW-3 (part of the Plume Stability Monitoring Network) is installed in the northern portion of this AOC. This well is screened in the MHU between 66.12 ft bgs and 71.12 ft bgs. During the March and June 2006 sampling events, the following organic RCRA hazardous constituents were detected above applicable TACO Tier 1 corrective action objectives for Class I groundwater (the maximum concentration is shown here):

- Benzene (6,500 µg/L)
- MCB (24,000 µg/L)
- 1,2-DCB (39,000 µg/L)
- 1,4-DCB (20,000 µg/L)
- p-Chloroaniline (380 µg/L)
- 1,2,4-TCB (1,500 µg/L)
- Total PCBs (49.6 µg/L)
- 2-Chlorophenol (38 µg/L)
- PCP (55 µg/L).

Even though there is no TACO Tier 1 corrective action objective for 1,3-DCB, this contaminant was detected at 2,400 µg/L and 1,200 µg/L during the two sampling events [Solutia, 2006a]. Overall, these results indicate that significant contamination attributable to historical operations at the Former Chlorobenzene Process Area is continuing to migrate into the MHU, to depths of up to 71 ft bgs.

### DNAPL

During the DNAPL investigation conducted at the facility in April and May 2004, four soil borings were advanced to bedrock within or in the immediate vicinity of the Former Chlorobenzene Process Area. These borings were located as follows:

- DNAPL-K-2: immediately downgradient from the former process area
- DNAPL-K-3: immediately downgradient from the former railcar loading area and upgradient from the former process area
- DNAPL-K-4: in the northern portion of the former process area



- DNAPL-K-5: between the former process area and the southern property boundary.

Soil samples were collected throughout the vertical depth of these borings (generally one sample for every ten-foot vertical depth of soil column) and were analyzed for VOCs and SVOCs. Total concentrations of MCB and DCBs were evaluated to determine if evidence of DNAPL existed, using the fugacity equation proposed by Feenstra, et al. and described in EPA [1992]:

$$C_w = \frac{C_t * \rho_b}{Kd * \rho_b + \phi_w}$$

Where:  $C_w$  = maximum solubility of the contaminant in water  
 $C_t$  = total concentration of the contaminant detected in soil  
 $\rho_b$  = dry bulk density of soil  
 $Kd$  = partition coefficient between pore water and soil solids  
 $\phi_w$  = water-filled porosity.

From these calculations, the presence of DNAPL was indicated at many depth intervals, as summarized in Table 3-4 [Solutia 2004a]:

**Table 3-4: DNAPL Occurrences in the Former Chlorobenzene Process Area**

Soil Boring	Total Depth (ft bgs)	Depth Intervals Containing DNAPL (ft bgs)
DNAPL-K-2	107	17 – 27
		94 – 107
DNAPL-K-3	108	9 – 88
DNAPL-K-4	112	9 – 59
		77 – 92
		111 – 112
DNAPL-K-5	115	4 – 22

From these results and inspection of the concentrations of MCB and DCBs detected in soil, the regions with the greatest concentrations of DNAPL are the vadose zone and the SHU, with a thinner layer of DNAPL immediately above the bedrock surface. These findings correlate well with the conceptual site model for releases at the Former Chlorobenzene Process Area (from surface spills and/or the failed sewer):

- The heterogeneous silty and silty sand soils in the vadose zone and SHU trap much of the DNAPL
- DNAPL occurs to a lesser degree in the well-flushed sand and gravel soils in the MHU and DHU
- A small volume of DNAPL is retained immediately above the soil/bedrock contact.



In addition, concentrations of MCB and total DCBs in soil samples collected from the vadose zone and the SHU indicate that there are three primary areas of potential DNAPL impact:

- In the northern portion of the AOC near borings DNAPL-K-4, S1207, and S1208
- In the central portion of the AOC, near where the 10,000 gallon MCB spill occurred (borings DNAPL-K-2, DNAPL-K-3, SB-03, SB-04, SB-07, SB-09, S0709, and S0713)
- Near the southern boundary of the AOC and southern property boundary of the facility, near borings DNAPL-K-5, S0710, and S0718.

Figures 3-2 through 3-5 are isoconcentration maps indicating the areas with the greatest concentrations of MCBs and total DCBs, in the vadose zone and the SHU, at the Former Chlorobenzene Process Area.

During the 2003 DNAPL investigation, a composite sample of separate-phase DNAPL was recovered from three piezometers in the Former Chlorobenzene Process Area that were associated with the former MPE system (PZ-1, PZ-7, and PZ-9). Two 40 milliliter (mL) vials of DNAPL were recovered and submitted for laboratory analysis of VOCs, SVOCs, pesticides and herbicides, PCBs, dioxins, and metals. Approximately 59 percent of the DNAPL volume was found to consist of six principal constituents (in descending order of weight fraction): MCB, PCE, benzene, 1,4-DCB, 1,2-DCB, and various polycyclic aromatic hydrocarbons (PAHs). MCB comprised 28 percent at a concentration of 280,000 mg/kg, and PCE comprised 23 percent at a concentration of 230,000 mg/kg.

A second sample bottle containing approximately 100 mL of DNAPL was submitted for laboratory analysis of its fluid properties (dynamic viscosity, density, surface tension, and interfacial tension with air and water). In addition, centrifugation tests were performed on soil cores from various locations and depths in the Former Chlorobenzene Process Area. Based on the small amount of free fluid bailed from the piezometers and on the centrifugation tests (which all produced no discernable free DNAPL), it was concluded that the majority of the DNAPL present in this area is residual and thus is more likely to be contained within the soil matrix pore spaces rather than flow freely toward and into a monitoring well. Nonetheless, this DNAPL still represents an uncontrolled source of ongoing contamination to groundwater, as evidenced by the recent results from monitoring well PSMW-3.

### Indoor Air

No indoor air sampling was performed at the Former Chlorobenzene Process Area during the 2003 site investigations, because no occupied structures were located in this area. Soil gas samples were collected from shallow borings in the general vicinity of the AOC, specifically borings SVP-8, SVP-10, and SVP-11. Sampling depth intervals were five ft bgs to 5.5 ft bgs for SVP-8, six ft bgs to 6.5 ft bgs for SVP-10, and 5.5 to six ft bgs for



SVP-11. Table 3-5 shows the RCRA hazardous constituents detected above EPA target concentrations for the vapor intrusion pathway [Solutia, 2003]:

**Table 3-5: Key Results of Soil Gas Sampling, Former Chlorobenzene Process Area**

RCRA Hazardous Constituents	Analytical Results, in ppbv			EPA Target Concentration for Vapor Intrusion
	Boring SVP-10, March 31, 2003	Boring SVP-10, August 20, 2003	Boring SVP-11	
Benzene	680	1,600	NE	98
MCB	31,000	61,000	NE	130
1,2-DCB	870	2,600	NE	330
1,4-DCB	4,500	14,000	NE	1,300
PCE	NE	NE	92	48

NE – No exceedances of EPA target concentration

### 3.2.3 Bench-Scale Tests

#### ISTD

At EPA's request, Solutia conducted a bench-scale treatability test of the ISTD technology on soil samples from the unsaturated and saturated zones in the Former Chlorobenzene Process Area. The samples were collected in proximity to prior soil borings SCTB-67 and DNAPL-K-4 at a depth of nine ft bgs (composite sample for the unsaturated zone) and in proximity to boring DNAPL-K-4 at a depth of 16.5 ft bgs (sample for the saturated zone). Prior investigations indicated that concentrations of MCB and DCBs in soil were greatest at these locations. Three sub-cores of each original soil core were subjected to heating, in a similar manner to the procedure described in Section 3.1.3; however, the applied temperatures were 100 °C (212 °F), 132 °C (270 °F), and 200 °C (392 °F). These temperatures were selected in order to "bracket" the boiling points of MCB and the three DCB isomers. In addition, the air stream passed through the saturated zone test cores was amended with moisture in a second oven to produce a steam/air mixture and thus simulate the effects of steam stripping as groundwater would be boiled off.

The measured mass reductions of MCB and DCBs resulting from the ISTD bench-scale treatability test for the vadose zone and SHU samples are presented in Table 3-6:

**Table 3-6: ISTD Bench-Scale Treatability Test Results for the Former Chlorobenzene Process Area**

RCRA Hazardous Constituents	Test Temperature		
	212 °F	270 °F	392 °F
<i>Vadose Zone Sample</i>			
MCB	99.996%	99.999%	99.999%



**Table 3-6: ISTD Bench-Scale Treatability Test Results for the Former Chlorobenzene Process Area**

RCRA Hazardous Constituents	Test Temperature		
	212 °F	270 °F	392 °F
1,2-DCB	99.717%	99.848%	99.985%
1,3-DCB	99.870%	99.950%	99.998%
1,4-DCB	99.780%	99.886%	99.994%
Total DCBs	99.772%	99.884%	99.991%
<b>Total MCB and DCBs</b>	<b>99.884%</b>	<b>99.941%</b>	<b>99.995%</b>
<i>SHU Sample</i>			
MCB	99.9889%	99.979%	99.989%
1,2-DCB	99.9998%	99.999%	99.999%
1,3-DCB	99.9986%	99.999%	99.999%
1,4-DCB	99.9996%	99.999%	99.999%
Total DCBs	99.9999%	99.999%	99.999%
<b>Total MCB and DCBs</b>	<b>99.9975%</b>	<b>99.997%</b>	<b>99.997%</b>

In the vadose zone sample, MCB was reduced from an initial concentration of 14,000 mg/kg to between 0.510 mg/kg and non-detectable (ND). Total DCBs were reduced from an initial concentration of 14,000 mg/kg to between 1,241 mg/kg and 31.9 mg/kg. In the SHU sample, MCB was reduced from an initial concentration of 560 mg/kg to between 0.066 mg/kg and 0.059 mg/kg. Total DCBs were reduced from an initial concentration of 1,900 mg/kg to between 0.02 mg/kg and ND [Solutia, 2006d].

### EABR

In the early part of 2006, Solutia conducted a bench-scale treatability test of the EABR technology on a sample of saturated soil from the SHU in the Former Chlorobenzene Process Area. The sample was collected near the location of boring DNAPL-K-4, from a depth interval of 14.5 ft bgs to 18.5 ft bgs. The soil sample was homogenized and then loaded into a treatment column. Following an equilibration period, oxygen gas was bubbled into a de-ionized water stream amended with nutrients and minerals to simulate groundwater conditions in the SHU at the facility. The oxygenated water was then pumped through the test column at velocities comparable to the known seepage velocities within the SHU. Soil sub-samples were collected prior to the EABR test, to establish baseline concentrations of RCRA hazardous constituents, and at the conclusion of the 12-week test period, to evaluate the effectiveness of treatment (i.e., mass removal of MCB and DCBs). Samples of effluent from the treatment column were also collected weekly and analyzed for MCB, DCBs, and key geochemical parameters [Solutia, 2006f].

The results from the EABR bench-scale test for the SHU are shown in Table 3-7:



**Table 3-7: Mass Reduction of MCB and DCBs, EABR SHU Bench-Scale Test**

Column Section	MCB	1,2-DCB	1,3-DCB	1,4-DCB
Front (upstream)	99.8%	96.2%	95.9%	96.6%
Middle	-8.6% <sup>a</sup>	-66.7%	-56.3%	-50%
End (downstream)	43.1%	16.7%	18.8%	23%
<b>Total Mass Reduction</b>	<b>45%</b>	<b>15%</b>	<b>19%</b>	<b>23%</b>

a. Negative values indicates increases in mass, based on pre- and post-test sample results.

These results were significantly inferior to the bench-scale test conducted using the ISTD technology on soil from the same aquifer and site location. In addition, the testing laboratory's calculations indicated that only an estimated 12 percent of the mass of MCB and DCBs removed during the test was attributable to biodegradation, with the remaining 88 percent attributed to simple flushing. Flushing contaminant mass from the source areas as the sole means of remediation is inconsistent with current EPA policy regarding control of source areas (including areas impacted by DNAPL) at RCRA corrective action sites [EPA, 1996 and 2005c].

### 3.2.4 Technology Evaluation

Because of the number of potentially applicable innovative and conventional technologies, a detailed technology evaluation was performed for the Former Chlorobenzene Process Area (Appendix C). A total of four ex-situ technologies and nine in-situ technologies were first screened to select the most promising candidate technologies. Based on the screening, the following four technologies were accepted for detailed evaluation against the ANPR threshold and balancing criteria:

- Low-temperature thermal desorption (LTTD)
- SVE
- ISTD
- Surfactant and co-solvent flushing.

**Threshold Criteria:** All four of the above technologies are considered capable of meeting the threshold criteria to some degree. By removing significant quantities of VOCs and SVOCs from contaminated soil at the Former Chlorobenzene Process Area, all four technologies would: (1) increase protection of human health and the environment; (2) facilitate progress toward meeting media cleanup standards; and (3) aid in controlling the source area. However, neither LTTD nor SVE is practicable for addressing DNAPLs below the water table (i.e., in the SHU). In addition, of the two in-situ technologies, only ISTD is known to have been tested at a site contaminated with MCB and DCBs (Eastland Woolen Superfund Site; refer to Appendix C).

**Balancing Criteria:** SVE and LTTD are conventional technologies with proven long-term effectiveness and reliability, while ISTD and surfactant or co-solvent flushing have also proven successful at a more limited number of sites (primarily at sites contaminated with



chlorinated ethenes or ethanes). Based on the pilot test at the Eastland Woolen Site, ISTD exhibited the potential to significantly reduce toxicity, mobility, and volume of VOCs and SVOCs in the vadose zone (via volatilization) and in the SHU (via steam stripping). The other three technologies have limitations with respect to contaminant mass reduction: (1) SVE is only effective for VOCs in the vadose zone; (2) LTTD can address VOCs and SVOCs, but excavation of soil beneath the water table is impracticable; and (3) surfactant and co-solvent flushing can potentially be used in the SHU, but field data is scarce or non-existent for most organic compounds other than petroleum hydrocarbons or chlorinated ethenes and ethanes. Potential short-term impacts include (depending on the technology): (1) fugitive and/or stack air emissions of chlorobenzenes and other contaminants; (2) emissions, traffic, and noise from diesel-powered trucks and equipment; (3) wastewater from scrubbers; and/or (4) solid or hazardous wastes such as spent activated carbon and scrubber sludge. The ISTD process requires substantial APC systems to adequately address acid gases and dioxins and furans, thus increasing its costs relative to the other technologies. Of the four technologies, unit costs for SVE are low to moderate, LTTD costs are moderate to high, and ISTD and surfactant/co-solvent flushing costs are generally high. Refer to Appendix C for a more extensive evaluation of the four technologies with respect to balancing criteria.

### ***3.2.5 Recommended Technology and Rationale***

The recommended technology for the Former Chlorobenzene Process Area is ISTD, for the following reasons:

- The bench-scale tests performed on soil samples from both the vadose zone and the SHU produced excellent results, with mass removals of MCB and DCBs greater than 99.9 percent at all test temperatures.
- A field pilot-scale test on soil contaminated with chlorobenzenes was conducted at the Eastland Woolen Site and produced generally positive results. The technology vendor (Terra-Therm, Inc. [TTI]) claims to clearly understand the changes to key operating parameters (particularly temperature) required to optimize mass removal. In addition, the ISTD technology is capable of achieving the elevated temperatures in the subsurface required to achieve destruction or removal of chlorobenzenes, based on its demonstrated performance at other sites.
- The time typically required to achieve significant contaminant mass and concentration reductions is relatively short compared to other technologies (i.e., on the order of months rather than years).
- The ISTD technology is capable of treating soil (above and below the water table) and groundwater simultaneously.
- PCE and other chlorinated ethenes present in the DNAPL will be destroyed and/or extracted at the temperatures required to facilitate remediation of MCB and DCBs.



- Remediation is performed in situ; no excavation or backfilling of soil is involved. In addition, the amount of waste requiring off-site treatment is significantly less than in other alternatives, which reduces the project's dependence on distant and costly off-site disposal facilities.
- Based on preliminary cost information, the costs associated with ISTD are comparable to those for the only other accepted technology capable of remediating both the vadose zone and SHU simultaneously (i.e., surfactant/co-solvent flushing).

### **3.2.6 Required Actions for Implementation**

The following actions are required prior to, or as the initial phase(s) of, implementing the recommended technology:

- A field pilot-scale test should be conducted in the Former Chlorobenzene Process Area, for soils in the vadose zone and SHU. The objectives of the field pilot-scale test are to: (1) evaluate the effectiveness of the ISTD technology under field conditions; (2) verify or correct assumptions made about the ideal operating temperatures for remediating MCB and DCBs; (3) evaluate the relative contributions of steam stripping in contrast to other mechanisms (e.g., volatilization); (4) evaluate parameters for scaling up the technology to the entire AOC; (5) determine dewatering practices or hydraulic controls required within, or at the upgradient boundary of, the AOC to aid in maintaining optimal temperatures in the SHU; and (6) collect data required to prepare a final corrective action cost estimate.
- The extent of DNAPLs should be adequately characterized. The DNAPL investigation conducted in 2005 did not completely delineate the extent of DNAPLs associated with the Former Chlorobenzene Process Area downgradient (to the west) and sidegradient (to the south) of the source area.

## **3.3 Former Chlor-Alkali Production Area – Vadose Zone and SHU**

### **3.3.1 Description**

The Former Chlor-Alkali Production Area is located in the southeastern corner of the facility, along the southern property boundary. It encompasses approximately 3.4 acres and is currently inactive. According to available documents, the Former Chlor-Alkali Production Area operated between approximately 1925 and the mid-1980s. The primary products were chlorine gas and caustic soda [Solutia, 2000].

The near-surface materials beneath the Former Chlor-Alkali Production Area consist of fill within the upper three to eight feet of soil (as much as 11 feet in the vicinity of boring SB0920), underlain by approximately ten feet of sandy clay. Based on boring logs for DNAPL-K-1 and DNAPL-K-10, the SHU is present beginning at 16 ft bgs to 18 ft bgs and extends down to approximately 29 ft bgs to 33 ft bgs. Based on site-wide geologic cross-sections and boring logs, the MHU is present in predominately sand deposits



between approximately 30 ft bgs and 55 ft bgs to 70 ft bgs at this AOC [Solutia, 2004b]. Sand and gravel deposits (the DHU) begin at 55 ft bgs to 70 ft bgs, and extend down to the bedrock surface at approximately 115 ft bgs (the final ten feet above the bedrock surface are characterized as gravel with cobbles) [Solutia, 2004a, 2005].

### 3.3.2 Site Investigation Results

#### Soil

During prior investigations, 12 soil borings were advanced in the Former Chlor-Alkali Production Area, and 35 soil samples were collected and analyzed from depths ranging between one ft bgs and 115 ft bgs. Organic compounds detected above TACO Tier 1 remediation objectives for industrial soil, along with the maximum concentrations detected at this AOC, are listed below:

- Benzene (15 mg/kg)
- MCB (39 mg/kg)
- 1,2-DCB (49 mg/kg)
- 2-Methylnaphthalene (22 mg/kg)
- PCE (3.8 mg/kg)
- TCE (0.06 mg/kg).

With the exception of 4.1 mg/kg of benzene and 6.4 mg/kg of MCB detected in boring DNAPL-K-1 (30 ft bgs to 33 ft bgs), all exceedances of TACO remediation objectives were in the vadose zone. Based on the available historical operations data, there are no readily-identifiable source(s) of VOCs or SVOCs in the Former Chlor-Alkali Production Area. In addition, boring DNAPL-K-1 was drilled in the extreme southeast corner of the site, in proximity to several of the off-site contaminated properties that comprise the SA1 CERCLA OU.

Arsenic was detected at 13 mg/kg in soil boring S0907, which is identical to the state-wide background concentration referenced in Appendix A of the TACO regulations [IEPA, 2002]. Mercury was detected at 1,000 mg/kg in soil boring S0904 (six ft bgs to eight ft bgs depth), which significantly exceeded the TACO Tier 1 remediation objectives and default background concentration for industrial soil. Attempts to delineate the extent of mercury contamination in the vicinity of soil boring S0904 are discussed below.

During the 2003 soil investigation and the 2005 supplemental soil investigation, a total of 20 soil borings were advanced in an area encompassing approximately 0.1 acres within the Former Chlor-Alkali Production Area. These soil borings were advanced to delineate the extent of mercury-impacted soil in the vicinity of boring S0904. This area, referred to as the "Mercury Area," is located north of 3<sup>rd</sup> Street and east of B Street. A total of 46 samples for analysis of total mercury were collected from the borings, at depths ranging from ground surface to 15 ft bgs. Mercury was detected in all of these samples at concentrations up to 940 mg/kg (in boring S0920). The areal extent of mercury exceeding the TACO direct contact criteria for industrial soil (61 mg/kg) comprises



approximately 500 square feet (ft<sup>2</sup>), and the depth of this contamination is approximately six ft bgs to seven ft bgs (in boring S0927). The areal extent of mercury exceeding the TACO soil to groundwater leaching criterion of 8 mg/kg has not been defined but is at least 2,000 ft<sup>2</sup>. The vertical extent of mercury exceeding the soil to groundwater leaching criterion is approximately 15 ft bgs at locations S0916 and S0919.

### Groundwater

No groundwater monitoring wells are installed in the SHU at this AOC. During the 2004 DNAPL investigation, VOCs were detected above the TACO Tier 1 remediation objectives in boring DNAPL-K-1 (30 ft bgs to 33 ft bgs). No accompanying potential presence of DNAPL was noted, and the concentration of MCB (6.5 mg/kg) was only slightly above the conservative Tier 1 objective of 1 mg/kg (migration to groundwater pathway).

### DNAPL

During the DNAPL investigation conducted at the facility in April and May 2004, two soil borings (DNAPL-K-1 and DNAPL-K-10) were advanced to bedrock at the eastern and western side, respectively, of the Former Chlor-Alkali Production Area. Soil samples were collected throughout the vertical depth of this boring (generally one sample for every ten-foot vertical depth of soil column) and were analyzed for VOCs and SVOCs. Concentrations of MCB and DCBs were evaluated to determine if evidence of DNAPL existed, using the fugacity equation presented in Section 3.2.2. From these calculations, the presence of DNAPL was indicated in the vadose zone at boring DNAPL-K-1, based on concentrations of 1,2-DCB detected at sampling depths of eight ft bgs to ten ft bgs and 15 ft bgs to 18 ft bgs [Solutia 2004a].

### Indoor Air

No indoor air sampling was performed at the Former Chlor-Alkali Production Area during the 2003 site investigations, because no occupied structures were located in this area. A soil gas sample was collected from a shallow soil boring (SVP-9) located north of the AOC; the sampling depth interval was from 4.3 ft bgs to 4.8 ft bgs. PCE was detected in SVP-9 above its corresponding EPA target concentration for the vapor intrusion pathway but below the respective OSHA PEL [Solutia, 2003].

## **3.3.3 Technology Evaluation**

### **3.3.3.1 Mercury-Contaminated Soil**

The site investigations indicated that approximately 150 yd<sup>3</sup> of soil are impacted above the Illinois TACO direct contact criteria. A larger, as yet undefined, volume of soil potentially exceeds the TACO migration to groundwater criterion for Class I groundwater. Technologies that were considered for remediation of the mercury-



impacted soil include: (1) capping, (2) excavation and off-site disposal, and (3) in-situ stabilization.

Threshold Criteria: All three technologies would mitigate risks to human health and the environment in the short term; the success of the capping alternative would be dependent on long-term (perhaps indefinite) maintenance of a cap. Capping would not provide progress toward attaining media cleanup standards. All three technologies would provide source control: (1) capping would prevent infiltration and leaching, (2) excavation would remove the contaminated soil, and (3) stabilization would fix the contaminants within the soil matrix. Excavated contaminated soil would need to be disposed in an off-site landfill—either a non-hazardous waste or hazardous waste facility, depending on the results of Toxicity Characteristic Leaching Procedure (TCLP) testing on the mercury-impacted soil.

Balancing Criteria: All three technologies are reliable and effective and have proven track records. Excavation and off-site disposal would reduce the toxicity, mobility, and volume of mercury at the facility but not overall (i.e., the contamination would be transferred to an off-site landfill without treatment). In-situ stabilization (if performed successfully) would reduce the mobility of mercury. For all three options, potential short-term impacts include noise, air emissions, and traffic associated with construction equipment. Potential impacts to storm water (on site and off site) would also need to be mitigated through measures such as berms, silt fences, and washing trucks before they leave the site. All three technologies are implementable and would not require special permits. While the initial costs associated with installing an impermeable cap (e.g., asphalt or concrete) above the impacted soil may appear lower than the other alternatives, the long-term maintenance and repair costs would eventually result in a greater life-cycle cost. Permanent groundwater monitoring wells and long-term sampling might also be required under the capping alternative.

#### 3.3.3.2 VOCs- and SVOCs-Contaminated Soil

For VOCs- and SVOCs-contaminated soil in the Former Chlor-Alkali Production Area, several candidate technologies were screened, and the results are as follows:

- Excavation and Off-Site Disposal (Accepted)
- Capping (Accepted) (note—the area is currently covered with gravel)
- SVE (Accepted)
- Bioventing (Accepted)
- Thermal Methods (Rejected, due to high cost of both in-situ and ex-situ methods for the projected volume of contaminated soil)



- Phytoremediation (Rejected, due to depth of soil contamination exceeding normal root structure depths).

Threshold Criteria: Capping (i.e., replacement of the gravel cap with a more impermeable surface) would prevent direct contact, ingestion, and inhalation exposures and minimize leaching of additional contaminants to groundwater. However, unlike the other three alternatives, capping would not reduce source mass. SVE could potentially remediate the VOCs, but would be ineffective for the SVOCs. Bioventing could potentially treat both VOCs and SVOCs if: (1) an adequate air supply could be provided to the impacted areas; and (2) the proper amounts of nutrients, moisture, and microbial colonies already exist in those areas. Of the four alternatives, excavation would generate the largest quantity of waste requiring off-site disposal. Excavation and SVE could both produce excess groundwater that requires treatment and discharge to the local sewer system, and ultimately to the American Bottoms Regional Wastewater Treatment Plant (WWTP).

Balancing Criteria: All four technologies have proven to be effective and reliable at numerous sites. SVE would only be effective at remediating VOCs. Bioventing, while theoretically capable of degrading SVOCs in soil, has been used much more frequently to address contamination from VOCs and petroleum SVOCs, rather than chlorinated SVOCs such as DCBs. Excavation would provide the largest degree of contaminant reduction (and greatest certainty that all contaminated material is removed). Due to the relatively small volume of VOCs-impacted soil in the vicinity of boring DNAPL-K-1 (and absence of elevated concentrations elsewhere within the Former Chlor-Alkali Production Area), excavation may be cost competitive with SVE and bioventing for remediation of VOCs.

Short-term impacts associated with these technologies include: (1) noise, traffic, and diesel exhaust emissions (excavation and cap construction), (2) fugitive emissions from soil piles (excavation), and (3) stack air emissions and wastewater generation (SVE). SVE and bioventing systems can be constructed with off-the-shelf equipment and would require on-site electrical power to operate the required blower(s), fan(s), or air compressors. The excavation option would require disposal capacity at an off-site landfill (whether the landfill is a hazardous waste or non-hazardous waste facility would depend on whether the VOCs and SVOCs contamination can be attributed to a spill[s] of listed hazardous wastes). If it is determined that the soil was contaminated by a listed waste, RCRA land disposal restrictions (LDRs) would apply, and pre-treatment of the soil prior to land disposal might be required.

### 3.3.3.3 VOCs in the SHU

At this time, there is insufficient data to select a remedial technology for VOCs in the SHU at the Former Chlor-Alkali Production Area. Additional characterization (e.g., direct-push groundwater sampling or temporary wells) should be performed to evaluate whether groundwater in the SHU has been impacted by VOCs. If groundwater contamination is detected, an appropriate technology must then be chosen.



### **3.3.4 Recommended Technologies and Rationale**

#### **3.3.4.1 Mercury-Contaminated Soil**

The recommended technology for addressing mercury-contaminated soil at the Former Chlor-Alkali Production Area is excavation and off-site disposal of all soil exceeding the TACO direct contact criteria for the following reasons:

- Potential direct contact exposures from the mercury “hot spot” would be completely and permanently eliminated. In addition, the migration to groundwater risk from the high levels of mercury would be considerably reduced.
- For the small volume of soil involved, excavation and off-site disposal is cost competitive with other alternatives (e.g., maintaining a cap and monitoring groundwater over an indefinite time period).
- Both non-hazardous and hazardous waste landfills are available in southern and central Illinois, within a reasonable driving distance from the facility.

A groundwater investigation is also required to determine if additional corrective measures are required for: (1) mercury-contaminated soil below the direct contact criteria but above the migration to groundwater criteria; and/or (2) the SHU (at present, it is not known whether the SHU has been impacted with mercury above Tier 1 groundwater remediation objectives). Refer to Section 3.3.5 for a description of the investigation requirements.

#### **3.3.4.2 VOCs- and SVOCs-Contaminated Soil**

The recommended technology for addressing VOCs- and SVOCs-contaminated soil at this AOC is also excavation and off-site disposal of soil exceeding applicable TACO criteria for industrial soil. The rationale is as follows:

- The volume of VOCs- and SVOCs-impacted soil appears to be relatively small, isolated to the area of boring DNAPL-K-1, and primarily within the vadose zone. Therefore, excavation would be cost competitive with in-situ remediation technologies such as SVE or bioventing, and would offer guaranteed removal of the contamination.
- Excavation equipment will already be on site to address the mercury-contaminated soil at this AOC, thus reducing mobilization time and cost.

### **3.3.5 Required Actions for Implementation**

The following actions are required prior to, or as the initial phase(s) of, implementing the recommended technologies:



- Appropriate disposal facilities should be located and unit prices obtained for disposal of the contaminated soil.
- The existing impacts of mercury or organics-contaminated soil on groundwater in the SHU are unknown, because no groundwater sampling has been performed. In addition, the potential for future leaching of mercury and/or organic RCRA hazardous constituents has not been characterized. Therefore, Solutia should conduct a groundwater assessment, which may include direct-push sampling, temporary monitoring wells, and/or permanent monitoring wells. If contaminants are detected above corresponding TACO groundwater remediation objectives, multiple sampling events may be required to evaluate trends. The results of groundwater sampling will indicate whether capping and MNA would be feasible for the soil left in place or whether more active corrective measures are required.

### **3.4 Former Lot F Drum Disposal Area – Vadose Zone and SHU**

#### **3.4.1 Description**

The Former Lot F Drum Disposal Area is located in the southwest corner of Lot F. It encompasses approximately 2.1 acres and is currently inactive. Based on a 1946 site plan, drum disposal in this area occurred prior to 1946. The 1946 site plan indicated that the Former Lot F Drum Disposal Area was 248 feet long by 40 feet to 42 feet wide and contained approximately 5,000 drums. An investigation of the depth of fill material indicated that the trench used for drum disposal was excavated to total depths of between ten ft bgs and 19.5 ft bgs.

In January 1985, 15 intact drums containing 98 percent dinitrochlorobenzene, 56 percent 2-nitrobiphenyl, 21 percent biphenyl, and nine percent 4-nitrobiphenyl were found during test excavations. On December 18, 1985, drum removal was initiated, during which two intact drums were removed. During excavation activities on December 19, 1985, many deteriorated drums were found to be present in the trench. A subsequent site inspection on January 16, 1986, indicated that the drums in the trench were badly decomposed, scattered throughout the trench, and surrounded by light-colored sandy soil that appeared to be impacted by spilled waste. It was determined that the decomposed drums and chemical waste could not be readily separated from the backfill soil.

Excavated wastes were shipped to the Rollins Environmental Services incinerator in Deer Park, Texas through March 1986. A total of 566,350 pounds of excavated wastes were placed in 2,580 20-gallon fiber packs and shipped to the incinerator during this period. An additional 89,330 pounds of excavated waste were sent to the incinerator in December 1986 and January 1987. Post-excavation sampling indicated that approximately 7,000 yd<sup>3</sup> of contaminated soil containing nitrochlorobenzene, dichloronitrobenzene, dinitrochlorobenzene, and nitrobiphenyl remained in the trench. Between October 5 and 31, 1987, a low-permeability cap consisting of compacted clay and a high-density polyethylene (HDPE) geomembrane liner was installed above the



former disposal trench [Solutia, 2004a]. A fence was also installed around the capped area to prevent unauthorized access, disturbance of the cap, and illegal dumping.

The near-surface materials beneath the Former Lot F Drum Disposal Area consist of silty clay and silty sand/sandy silt, transitioning to predominantly sand at approximately 16 ft bgs. Based on the facility-wide geologic cross section, sand deposits are present from approximately 16 ft bgs to 80 ft bgs, followed by sand and gravel deposits that extend down to the bedrock surface at approximately 125 ft bgs [Solutia, 2004b].

### **3.4.2 Site Investigation Results**

#### Soil

Solutia conducted soil sampling at the Former Lot F Drum Disposal Area as part of the CMS soil investigations in March and October 2003. A total of three soil borings were advanced, and six soil samples were collected and analyzed, at depths ranging from the ground surface to 15 ft bgs. A soil sample was also collected from a 40-foot long trench excavated in the Former Lot F Drum Disposal Area. No exceedances of the TACO Tier 1 remediation objectives for industrial soils were detected in the soil samples.

#### Groundwater

Solutia conducted groundwater sampling during the August 2005 supplemental groundwater investigation at the Former Lot F Drum Disposal Area. A total of eight existing monitoring wells screened in the SHU, MHU, and DHU were redeveloped and sampled, and the groundwater samples were analyzed for SVOCs and PCBs. SVOCs detected above the TACO Tier 1 remediation objectives for Class I groundwater in monitoring wells screened in the SHU included 2,4,6-trichlorophenol, nitrobenzene, and PCP. Bis(2-ethylhexyl)phthalate, a common laboratory contaminant, was detected in both monitoring wells screened in the MHU (GM-31B and GM-54B) at concentrations exceeding the TACO Tier 1 remediation objective for Class I groundwater. The concentration of p-chloroaniline (1,400 µg/L) detected in monitoring well GM-31C, screened in the DHU, also exceeded the TACO Tier 1 remediation objective for Class I groundwater.

#### Indoor Air

No indoor air sampling was performed at the Former Lot F Drum Disposal Area during the 2003 site investigations, because no occupied structures were located at this AOC.

### **3.4.3 Technology Evaluation**

For the Former Lot F Drum Disposal Area, the following candidate technologies were screened, and the results are as follows:



- Excavation and Off-Site Disposal of Contaminated Soil (Rejected, due to high cost and disturbance of the existing cap)
- Capping and MNA (Accepted)
- Capping and Pump and Treat (Accepted)
- Capping and Enhanced Bioremediation (Rejected, due to difficulty in ensuring adequate dispersion of reagents within the silty, heterogeneous soils of the SHU)
- Capping and Permeable Reactive Barrier (PRB) (Accepted).

Threshold Criteria: All of the accepted alternatives have the potential to achieve progress toward the applicable CMOs. The existing cap will eliminate ingestion or inhalation hazards associated with the contaminated soil and prevent additional infiltration of precipitation and consequent leaching. No off-site disposal of wastes would be required under any of the three alternatives. Either a pump-and-treat system or a PRB could be used to prevent downgradient migration of contaminated groundwater in the SHU.

Balancing Criteria: All three of the accepted technologies would provide long-term management of existing contamination but would likely require long-term O&M and monitoring. Pumping and treating contaminated groundwater would require a discharge point for the treated effluent (probably the nearby American Bottoms WWTP), and a per-gallon treatment cost would be incurred. Of the three alternatives, only a PRB would be capable of potentially providing significant reduction in toxicity, mobility, and volume of contaminants (in groundwater only), although there are few if any documented results of zero-valent iron (ZVI) PRBs remediating groundwater impacted with chlorobenzenes. Moreover, the impacted soil and SHU groundwater at the Former Lot F Drum Disposal Area do not appear to represent a significant threat to groundwater in the MHU or DHU or to the Mississippi River at this time. All three alternatives have been implemented at numerous sites and would not require any special licenses or pilot studies.

#### ***3.4.4 Recommended Technologies and Rationale***

The recommended corrective measures for the Former Lot F Drum Disposal Area are continued maintenance of the existing RCRA cap and MNA, with a PRB available as a contingent remedy in case groundwater contamination is not being controlled. The rationale is as follows:

- The existing cap has been installed and is consistent with RCRA design requirements.
- Monitoring well PSMW-9 (part of the plume stability monitoring network in the MHU – refer to Section 3.11) is located immediately downgradient of the Former Lot F Drum Disposal Area and can therefore be used to detect/monitor any potential impacts from the in-place contaminated soil. In addition, no RCRA hazardous constituents were detected in PSMW-9 above the respective TACO remediation



objectives during the first two plume stability monitoring events in March and June 2006.

- Pumping and treating groundwater is best employed for hydraulic control of plumes associated with disposal areas. In terms of contaminant mass recovered per gallon of groundwater pumped, pump and treat is generally inefficient, and such systems tend to approach asymptotic limits of contaminant concentrations relatively quickly.
- There is insufficient data indicating whether the plume in the SHU is stable. If it is unstable, a PRB could be used to control downgradient migration and protect the river (this AOC is outside the capture area of the GMCS). However, further monitoring may indicate that MNA is effectively preventing horizontal downgradient migration and/or vertical migration of RCRA hazardous constituents into the MHU.

### **3.4.5 Required Actions for Implementation**

The following actions are required prior to, or as the initial phase(s) of, implementing the recommended technology:

- A monitoring well network, consisting of existing and/or newly installed wells, must be established in the SHU. A work plan for implementation of MNA should also be prepared (additional guidelines for this type of work plan are described in Section 3.11.7).
- An O&M plan for the existing cap should be prepared, if one has not already been developed. The plan should specify inspection of the cap surface and fence condition on a quarterly frequency, at a minimum. The O&M plan should also specify that any required repairs (e.g., filling erosion channels, re-vegetating the cap surface) will be performed promptly (e.g., within 30 days of discovery).

## **3.5 Central Plant Process Area – Vadose Zone and SHU**

### **3.5.1 Description**

The Central Plant Process Area is located in the central portion of the facility, south of 2<sup>nd</sup> Street, east of State Route 3, west of G Street, and north of 5<sup>th</sup> Street. It encompasses approximately 20 acres and is currently inactive. This AOC includes the north tank farm, which contains the former benzyl chloride residue tank, ketone residue tank, and former steamer overhead tank (all tanks at this AOC are ASTs). The benzyl chloride residue tank and steamer overhead tank have been dismantled and are inactive HWMUs; the ketone residue tank is an active HWMU. The “Little Mo” benzene tank is also located in the Central Plant Process Area.

The near-surface materials in the Central Plant Process Area consist of three to five feet of fill. The fill is underlain by between seven and 12 feet of a mixture of silty clay, silty sand/sandy silt, and silt. Based on facility-wide geologic cross sections and the boring



log for monitoring well PSMW-4 (part of the Plume Stability Monitoring Network), the SHU and MHU are present in predominately sand deposits beginning at between ten ft bgs to 15 ft bgs, down to approximately 50 ft bgs to 55 ft bgs. Based on the limited available data, it is difficult to distinguish between the SHU and MHU in this area. From approximately 50 ft bgs to 55 ft bgs, to the top of limestone bedrock at approximately 105 ft bgs, sand and gravel with some cobbles are present and form the DHU (the final ten ft to 15 ft above the bedrock are characterized as gravel with cobbles) [Solutia, 2004a and 2006c].

### **3.5.2 Site Investigation Results**

#### Soil

During pre-CMS site investigations (i.e., prior to 2003), a total of 23 soil borings were advanced in proximity to the north tank farm. Soil samples were collected and analyzed at depths ranging from ground surface to 16 feet bgs in these borings. The results were reported as total VOCs, total SVOCs, and total PCBs, rather than for specific RCRA hazardous constituents. Total VOCs were detected in soil samples from 22 of the 23 soil borings at concentrations up to 30,034 mg/kg. Total SVOCs were detected in 21 of the 23 soil borings at concentrations up to 245 mg/kg. Total PCBs were detected in one soil boring (B-39) above 25 mg/kg (i.e., the concentration above which corrective action is required under the Mega Rule for closure in place of PCBs-impacted soils at "low occupancy" properties [EPA, 1999]). In addition, a total of seven borings were advanced in the vicinity of the former steamer overhead tank located south of the north tank farm. Total VOCs were detected in soil samples from the seven borings at concentrations up to 56,300 mg/kg [Solutia, 2004a].

During the 2003 CMS soil investigations in the Central Plant Process Area, a total of 27 borings were advanced and 51 samples were collected and analyzed, at depths ranging from ground surface to 16 ft bgs. One soil boring was advanced in the vicinity of Sump 277. The organic RCRA hazardous constituents detected above TACO Tier 1 remediation objectives for industrial soil are listed in Table 3-8 below.



**Table 3-8: Organic RCRA Hazardous Constituents Detected in Soil in the Central Plant Process Area**

RCRA Hazardous Constituents	Number of Exceedances	Maximum Detected Concentration (mg/kg)
Benzene	12	1,600
MCB	9	1,100
2-methylnaphthalene	3	4.4
Chloromethane	2	9.6
BAP	2	1.3
Acetone	1	64
PCE	1	0.22
Carbazole	1	17
Dibenzo(a,h)anthracene	1	0.49

Arsenic (56 mg/kg), copper (27,000 mg/kg), iron (140,000 mg/kg), and lead (770 mg/kg) were detected in soil boring S0502, located on the east side of the north tank farm, at concentrations exceeding TACO Tier 1 remediation objectives for industrial soil. In addition, arsenic concentrations exceeded TACO Tier 1 remediation objectives for industrial soil in three soil borings (S0511, S0512, and S0714) in the southern portion of the Central Plant Process Area and in one soil boring (S0428) on the western side of the AOC. Lead concentrations exceeded the TACO Tier 1 remediation objectives for industrial soils in one soil boring (S0720) on the eastern side of this AOC and in one soil boring (S0512) in the southern portion of the AOC. The detected concentration of lead in boring S0512 was 1,000 mg/kg.

#### Groundwater

No permanent monitoring wells screened in the SHU have been installed in the Central Plant Process Area. However, monitoring well PSMW-4 (part of the Plume Stability Monitoring Network) is installed in the vicinity of the north tank farm. This well is screened in the DHU between 99.96 ft bgs and 104.96 ft bgs. During the March 2006 sampling event, the following organic RCRA hazardous constituents were detected above applicable TACO Tier 1 remediation objectives for Class I groundwater:

- Benzene (1,600 µg/L)
- MCB (30,000 µg/L)
- 1,2-DCB (1,200 µg/L)
- 1,4-DCB (8,400 µg/L)
- p-Chloroaniline (69 µg/L)
- Total PCBs (1.43 µg/L).

Even though there is no TACO Tier 1 remediation objective for 1,3-DCB, this RCRA hazardous constituent was detected at 370 µg/L in PSMW-4 [Solutia, 2006a].



### Indoor Air

In March and September 2003, Solutia conducted sampling and analysis of indoor air at the Building BBZ storeroom, which is located in the Central Plant Process Area. During the September 2003 sampling event, MCB was detected above the EPA target concentration for the vapor intrusion exposure pathway but below the OSHA PEL. Solutia also collected soil gas samples from two shallow soil borings located in the Central Plant Process Area: (1) SVP-14, located in the vicinity of the north tank farm; and (2) SVP-16, located on the southeast side of Building BBZ. The sampling depth intervals were from five ft bgs to 5.5 ft bgs and 4.5 ft bgs to five ft bgs, respectively. In the soil gas sample from SVP-14, benzene was detected above its EPA target concentration for the vapor intrusion pathway and also above its OSHA PEL. MCB and 4-methyl-2-pentanone were detected above their respective EPA target concentrations for the vapor intrusion pathway and below their respective OSHA PELs. No RCRA hazardous constituents were detected above EPA target concentrations for the vapor intrusion pathway or OSHA PELs in the soil gas sample from SVP-16 [Solutia, 2003].

### **3.5.3 Technology Evaluation**

#### **3.5.3.1 VOC-Contaminated Soil in the Vadose Zone**

Elevated concentrations of benzene and MCB were detected in soil throughout the vadose zone, including directly above the water table, at this AOC. The highest concentrations were: (1) 1,100 mg/kg of benzene in sample S0516 (seven ft bgs to eight ft bgs); (2) 1,600 mg/kg of benzene and 1,100 mg/kg of MCB in sample S0428 (six ft bgs to eight ft bgs); (3) 810 mg/kg of MCB in sample S0428 (14 ft bgs to 16 ft bgs); and (4) 560 mg/kg of MCB in sample S0502 (six ft bgs to eight ft bgs). These concentrations indicate the likely need for source control measures to prevent further impacts to groundwater and to mitigate vapor intrusion risks (i.e., when the property is redeveloped).

For VOCs in the vadose zone at the Central Plant Process Area, the following candidate technologies were screened, and the results are as follows:

- Excavation and Off-Site Disposal (Accepted)
- Capping (Accepted) (as stated above, hot spots in this area may require active remediation)
- SVE (Accepted)
- Bioventing (Accepted)
- Thermal Methods (Rejected, due to high cost; the VOCs detected at this AOC are readily volatilized under ambient temperature and pressure)



- Phytoremediation (Rejected, due to depth of contaminated soil exceeding normal root zone depths; also, because there is no redevelopment plan for this area, it is unknown whether phytoremediation areas could be situated in this portion of the facility).

Threshold Criteria: Capping (replacement of the gravel cap with a more impermeable surface) would prevent direct contact/ingestion exposures and potentially reduce upward vapor transport of VOCs and/or leaching to groundwater. However, unlike excavation and SVE, capping would not reduce source mass. Both SVE (with or without bioventing as a polishing step) and excavation have a good probability of achieving media cleanup standards, especially if risk-based TACO Tier 2 or Tier 3 remediation objectives are developed for the VOCs of concern. Of the four alternatives, excavation would generate the largest quantity of waste requiring off-site disposal. Excavation and SVE could both produce excess groundwater requiring treatment and discharge to the local sewer system, and ultimately to the American Bottoms WWTP.

Balancing Criteria: All four technologies have proven to be effective and reliable at numerous sites. Excavation would provide the largest degree of contaminant reduction (and greatest certainty that all contaminated soil is removed); however, it would also have the greatest cost. Short-term impacts associated with these technologies include: (1) noise, traffic, and diesel exhaust emissions (excavation and cap construction); (2) fugitive emissions from soil piles (excavation); and (3) stack air emissions and wastewater generation (SVE). Off-gas treatment using activated carbon canisters or catalytic oxidizers is often required to meet emissions limits on VOCs from SVE systems. SVE and bioventing systems can be constructed with off-the-shelf equipment and would require on-site electrical power; excavation would require disposal capacity at an off-site landfill (probably a hazardous waste facility, assuming that the soil contamination was caused by listed hazardous wastes). Furthermore, the contaminated soil would likely require pre-treatment at the disposal facility to meet RCRA LDRs, and the nearest permitted hazardous waste disposal facility may be some distance from the Krummrich facility.

#### 3.5.3.2 Metals-Contaminated Soil in the Vadose Zone

The site investigation indicated elevated concentrations (i.e., significantly above typical natural background levels in Illinois) of lead in borings S0502 and S0720 and arsenic in boring S0502. Technologies considered for remediation of the metals-contaminated soil include: (1) capping, (2) excavation and off-site disposal, and (3) in-situ stabilization/solidification (S/S).

Threshold Criteria: All three technologies would mitigate risks to human health and the environment in the short term; the success of the capping alternative is dependent on long-term (perhaps indefinite) maintenance of the cap. In addition, capping would not provide progress toward attaining media cleanup standards for soil. All three technologies would provide source control: (1) capping would prevent further infiltration and leaching, (2) excavation would remove the contaminated soil, and (3) in-situ S/S would fix the contaminants within the soil matrix. Excavated contaminated soil would



need to be disposed in an off-site landfill—either a non-hazardous waste facility or a hazardous waste facility, depending on the results of TCLP testing on the lead- and arsenic-impacted soil and on whether the metals-contaminated soils also contained VOCs causing the soil to be a listed waste.

**Balancing Criteria:** All three technologies are reliable and effective and have proven track records for metals-contaminated soils. Excavation and off-site disposal would reduce the toxicity, mobility, and volume of lead and arsenic at this AOC but not overall (i.e., the contamination would be transferred to the landfill without treatment). In-situ S/S (if performed successfully) would reduce the mobility of these heavy metals. For all three options, potential short-term impacts include noise, air emissions, and traffic associated with excavation and construction equipment. Potential impacts to storm water (on site and off site) would also need to be mitigated through measures such as berms, silt fences, and washing trucks before they leave the site. All three technologies are implementable and would not require special permits. While the costs associated with installing an impermeable cap (e.g., asphalt or concrete) above the metals-impacted soil may appear lower than the other alternatives, the long-term maintenance and repair costs would eventually result in a greater life-cycle cost. Permanent groundwater monitoring wells and long-term sampling of groundwater in the SHU might also be required under the capping alternative, to confirm that the metals are not leaching into groundwater.

### ***3.5.4 Recommended Technologies and Rationale***

#### **3.5.4.1 VOCs-Contaminated Soil in the Vadose Zone**

The recommended corrective measure for VOCs-contaminated soil in the vadose zone at the Central Plant Process Area is SVE. The rationale is as follows:

- A considerable volume of contaminated soil in the vadose zone at this AOC is impacted by VOCs (benzene and MCB) that are generally amenable to recovery by SVE.
- SVE is a proven technology, with relatively low costs compared to other options (e.g., excavation). It can also be quickly implemented using skid-mounted or permanent systems combined with vertical or horizontal extraction wells. It usually achieves rapid reductions in VOC concentrations, particularly in areas where parts-per-million order concentrations are present.
- Like other advection-based technologies, SVE systems tend to approach asymptotic limits in contaminant concentrations over time. However, the ability to use CMOs based on industrial land use at the facility increases the potential that an SVE system would provide adequate reductions of VOCs concentrations in soil.



#### 3.5.4.2 Metals-Contaminated Soil in the Vadose Zone

The recommended corrective measure for metals-contaminated soil in the vadose zone at the Central Plant Process Area is excavation and off-site disposal. The rationale is as follows:

- The metals-impacted areas are isolated and close to the ground surface (i.e., less than eight ft bgs), and thus are easily accessible using conventional digging equipment (e.g., backhoes).
- Other in-situ or ex-situ technologies for addressing metals-contaminated soil would likely not be cost-competitive with excavation, unless further investigation shows that the extent of metals impacts is considerably larger than it appears at present.
- This soil may need to be removed as part of site redevelopment (e.g., for installing foundations). Contaminated soil that is excavated would be replaced with clean fill, thus facilitating redevelopment.
- Landfills capable of accepting RCRA non-hazardous or hazardous metals-contaminated soils are available in southern and central Illinois.

#### 3.5.4.3 Groundwater in the SHU

A groundwater investigation is required to determine if corrective measures are required for the SHU (at present, it is not known whether the SHU has been impacted with VOCs, lead, and/or arsenic above TACO Tier 1 groundwater remediation objectives).

#### 3.5.5 *Required Actions for Implementation*

The following actions are required prior to, or as the initial phase of, implementing the recommended technologies:

- A conceptual design of the SVE system would need to be prepared. Because of the potentially significant volume of VOCs-impacted soil and the heterogeneous stratigraphy of the vadose zone at the facility, it is recommended that a field pilot test be conducted to establish design parameters such as radius of influence (ROI) and maximum achievable vacuum. In situations where the areal extent of the contamination is large or the impacted areas are separated by non-impacted areas, the best design strategy may be to construct two or more independent SVE systems, as opposed to a single, interconnected system.
- The metals-contaminated soil must be tested to determine whether it is a characteristic hazardous waste (i.e., using the TCLP procedure). Applicable EPA methods for selecting sample size and sampling locations should be followed [EPA, 2002]. Based on the waste characterization sampling results, appropriate disposal



facilities should be located and unit prices obtained for disposal of the metals-contaminated soil.

- Groundwater quality in the SHU at the Central Plant Process Area should be evaluated. A two-phase investigation, consistent with EPA's Triad methodology, may be employed: (1) conduct direct-push sampling to define the horizontal and vertical extent of contamination and identify locations for monitoring wells; and (2) install, develop, and sample monitoring wells to confirm the results of the direct-push investigation and evaluate contaminant concentrations and geochemical parameters in the SHU.

### **3.6 Former Chlorobenzene and Benzene Storage Area – Vadose Zone and SHU**

#### **3.6.1 Description**

The Former Chlorobenzene and Benzene Storage Area is located in the southwestern corner of the facility, south of 5<sup>th</sup> Street and east of Route 3. It encompasses approximately 7.2 acres and is currently inactive. Benzene and MCB were once stored in this area. This area includes the "Big Mo" benzene AST, which is located in the northwestern portion of the former storage area. The former Hazardous Waste Accumulation Area (a HWMU) was also located within this AOC.

The near-surface materials beneath the Former Chlorobenzene and Benzene Storage Area consist of fill within the upper three to six feet of soil. The fill is underlain by approximately 70 feet of sand in the southeastern portion of the AOC. In the southwestern portion of the storage area, the fill is underlain by seven feet of silt, followed by five feet of silty sand, and transitions into predominately sand at 18 ft bgs. Based on the boring logs for DNAPL-K-6, DNAPL-K-7, DNAPL-K-8 and DNAPL-K-11, the SHU is present beginning at between 13 ft bgs and 15 ft bgs and extends down to approximately 33 ft bgs to 43 ft bgs in this AOC. Based on the facility-wide geologic cross section and boring logs, the MHU is present between approximately 33 ft bgs to 43 ft bgs and 75 ft bgs in this area [Solutia, 2004b]. Predominately sand and gravel deposits (the DHU) begin at 75 ft bgs and continue down to the bedrock surface at approximately 112 ft bgs (the final ten feet above the bedrock surface are characterized as gravel with cobbles) [Solutia, 2004a].

#### **3.6.2 Site Investigation Results**

##### Soil

During the 2003 soil investigations, a total of 19 soil borings were advanced in the Former Chlorobenzene and Benzene Storage Area, and 74 soil samples were collected and analyzed, at depths ranging from one ft bgs to 112 feet bgs. In addition, four soil samples were collected from three trenches (CT-1, CT-2a, and CT-2b) excavated in the north-central portion of this AOC. The organic compounds detected above TACO Tier 1 remediation objectives for industrial soil are listed in Table 3-9 below.



**Table 3-9: Organic RCRA Hazardous Constituents Detected in Soil in the Former Chlorobenzene and Benzene Storage Area**

RCRA Hazardous Constituents	Number of Exceedances	Maximum Detected Concentration (mg/kg)
Benzene	23	2,400
MCB	18	19,000
Total PCBs	6	1,090
Dichloromethane	5	1.7
3,3-Dichlorobenzidine	5	22
2,4,6-Trichlorophenol	4	4.9
PCP	3	31
p-Chloroaniline	3	2.2
2,4-Dichlorophenol	2	5.7
Acetone	1	94
Ethylbenzene	1	15
Chloromethane	1	0.19
PCE	1	0.41
1,4-DCB	1	2.4
1,2,4-TCB	1	8.5
2-Methylnaphthalene	1	2.8
Naphthalene	1	15
N-Nitrosodiphenylamine	1	4

Arsenic and lead concentrations in six samples and three samples, respectively, exceeded TACO Tier 1 remediation objectives for industrial soil. Arsenic was detected at concentrations up to 37 mg/kg, and lead was detected at concentrations up to 1,300 mg/kg at this AOC.

#### Groundwater

Monitoring well PSMW-5 (part of the Plume Stability Monitoring Network) is located on the northwestern side of the Former Chlorobenzene and Benzene Storage Area. This well is screened in the SHU between 19.68 ft bgs and 24.68 ft bgs. During the March and June 2006 sampling events, benzene (490,000 µg/L and 880,000 µg/L, respectively) and phenol (140 µg/L and 170 µg/L, respectively) were detected in well PSMW-5 above applicable TACO Tier 1 remediation objectives for Class I groundwater.



## DNAPL

During the DNAPL investigation conducted at the facility in April and May 2004, four soil borings (DNAPL-K-6, DNAPL-K-7, DNAPL-K-8, and DNAPL-K-11) were advanced to bedrock within the Former Chlorobenzene and Benzene Storage Area. Soil samples were collected throughout the vertical depths of these borings (generally one sample for every ten-foot vertical depth of soil column), and were analyzed for VOCs and SVOCs. No evidence of MCB or DCBs DNAPLs was detected, based on an analysis of soil concentrations using the fugacity equation discussed in Section 3.2.3 of this Report. However, benzene LNAPL may be present in a smear zone across the lower portion of the vadose zone and the upper portion of the SHU. Benzene was detected at 2,000 mg/kg in sample DNAPL-K-8 (15 ft bgs to 18 ft bgs) and at 250 mg/kg in sample DNAPL-K-8 (23 ft bgs to 25 ft bgs).

## Indoor Air

No indoor air sampling was performed at the Former Chlorobenzene and Benzene Storage Area during the 2003 site investigations, because no occupied structures were located in this area. Two shallow soil borings were advanced, and a soil sample was collected from each boring as follows:

- SVP-13A, located in the general vicinity of the former "Big Mo" benzene AST, from a depth interval of 3.5 ft bgs to four ft bgs
- SVP-15, located on the south side of the AOC, from a depth interval of 5.5 ft bgs to six ft bgs.

In the air sample from boring SVP-13A, PCE and cis-1,2-DCE were detected above their respective EPA target concentrations for the vapor intrusion pathway and below the respective OSHA PELs. No RCRA hazardous constituents were detected above the EPA target concentrations for the vapor intrusion pathway or OSHA PELs in the soil gas sample from SVP-15 [Solutia, 2003].

### **3.6.3 Technology Evaluation**

#### **3.6.3.1 SVOCs-, PCBs-, and Metals-Contaminated Soil in the Vadose Zone**

The various site investigations at this AOC indicated that isolated exceedances of the TACO Tier 1 industrial remediation objectives for metals (particularly lead), PCBs, and several SVOCs have been detected in shallow soil (i.e., less than eight ft bgs). The horizontal and vertical extent of these impacts have not been fully characterized. Technologies considered for remediation of the SVOCs-, PCBs-, and metals-contaminated soil included: (1) capping, (2) excavation and off-site disposal, and (3) in-situ S/S.



Threshold Criteria: All three technologies would mitigate risks to human health and the environment in the short term; the success of the capping alternative is dependent on long-term (perhaps indefinite) maintenance of the cap. In addition, capping would not provide progress toward attaining media cleanup standards for soil. All three technologies would provide source control: (1) capping would prevent further infiltration and leaching, (2) excavation would remove the contaminated soil, and (3) stabilization would fix the contaminants within the soil matrix. Excavated contaminated soil would need to be disposed in an off-site RCRA- and TSCA-permitted landfill (due to the presence of both RCRA hazardous constituents and PCBs).

Balancing Criteria: All three technologies are reliable and effective and have proven track records for contaminated soils. As discussed in Appendix B, there are a limited number of sites where in-situ S/S has been used to address PCBs, and based on those case histories, there is some doubt as to whether leachate from the stabilized soils would meet the TACO criteria for protection of groundwater. Excavation and off-site disposal would reduce the toxicity, mobility, and volume of contaminated soil at the Former Chlorobenzene and Benzene Storage Area; however, the contamination would merely be transferred to an off-site facility rather than destroyed. In-situ S/S (if proven successful) would reduce the mobility of metals, PCBs, and SVOCs, but not necessarily the volume or toxicity. For all three options, potential short-term impacts include noise, air emissions, and traffic associated with excavation and construction equipment. Potential impacts to storm water (on site and off site) would also need to be mitigated through measures such as berms, silt fences, and washing trucks before they leave the site.

All three technologies are implementable, although in-situ S/S would require bench-scale and or pilot-scale testing before implementation (the costs of which would probably not justify using this technology for the rather small volumes of impacted soil at this AOC). While the costs associated with installing an impermeable cap above the impacted soil may appear lower than other alternatives, the long-term maintenance, repair, and groundwater monitoring costs would eventually result in a greater life-cycle cost.

### 3.6.3.2 VOCs Contamination in the Vadose Zone

For VOCs in the vadose zone at the Former Chlorobenzene and Benzene Storage Area, the following candidate technologies were screened, and the results are as follows:

- Excavation and Off-Site Disposal (Accepted)
- Capping (Accepted) (note – this area is currently covered with gravel)
- SVE (Accepted)
- Bioventing (Accepted as a potential second stage of corrective measures after sufficient VOCs-impacted source mass is removed)



- Thermal Methods (Rejected, due to high cost; the VOCs detected at this AOC are readily volatilized under ambient temperature and pressure)
- Phytoremediation (Rejected, due to magnitude of soil contamination and depth of contaminated soil exceeding normal root structure depths).

Threshold Criteria: Capping (replacement of the gravel cap with a more impermeable surface) would prevent or limit direct contact, ingestion, and inhalation exposures and minimize leaching of additional contaminants to groundwater. However, unlike excavation and SVE, capping would not reduce source mass. Both SVE (with or without bioventing as a “polishing” step) and excavation have a good probability of achieving media cleanup standards, especially if risk-based TACO Tier 2 or Tier 3 remediation objectives are developed for the VOCs of concern. Of the four alternatives, excavation would generate the largest quantity of solid and/or liquid waste requiring off-site disposal. Excavation and SVE could both produce excess groundwater requiring treatment and discharge to the local sewer system, and ultimately to the American Bottoms WWTP.

Balancing Criteria: All four technologies have proven to be effective and reliable at numerous sites. Excavation would provide the largest degree of contaminant reduction (and greatest certainty that all contaminated soil is removed); however, it would also have the greatest cost. Short-term impacts associated with these technologies include: (1) noise, traffic, and diesel exhaust emissions (excavation and cap construction); (2) fugitive air emissions from soil piles (excavation); and (3) stack air emissions and wastewater generation (SVE). Off-gas treatment using activated carbon canisters or catalytic oxidizers is often required to meet regulatory requirements for air emissions from SVE systems. SVE systems can be constructed with off-the-shelf equipment and would require on-site electrical power; excavation would require disposal capacity at an off-site landfill (probably a hazardous waste facility, assuming that the soil contamination was caused by listed hazardous wastes). Furthermore, the contaminated soil would likely require pre-treatment at the disposal facility to meet RCRA LDRs, and the nearest permitted hazardous waste disposal facility may be located some distance from the facility.

#### 3.6.3.3 VOCs Contamination in the SHU

There is currently insufficient data to select a remedy for VOCs in the SHU. The impacted area is in the vicinity of boring DNAPL-K-8 and Plume Stability Monitoring Well PSMW-5, along the western edge of the Former Chlorobenzene and Benzene Storage Area. A more complete characterization of the horizontal and vertical extent of VOCs contamination will be required (refer to Section 3.6.5 below). In addition, Solutia should continue to collect geochemical data at the existing well and any new wells, because those parameters may dictate the type of remedy most applicable to this situation.



The June 2006 geochemical sampling indicated that anaerobic, possibly iron-reducing, conditions at well PSMW-5. Furthermore, elevated concentrations of benzene (like those detected in the SHU at this AOC) can act as a supplemental carbon source to stimulate reductive dechlorination of chlorinated compounds, if reducing conditions are maintained in the aquifer. Because the concentrations of chlorinated VOCs are apparently low in this area, the key to maintaining anaerobic degradation processes may be the availability of ferric iron (Fe III), which serves as an electron acceptor while being reduced to ferrous iron (Fe II).

### **3.6.4 Recommended Technologies and Rationale**

#### **3.6.4.1 SVOCs, PCBs, and Metals-Contaminated Soil**

The recommended corrective measure for SVOCs-, PCBs-, and metals-contaminated soil in the vadose zone at the Former Chlorobenzene and Benzene Storage Area is excavation and off-site disposal. The rationale is as follows:

- The metals-impacted areas are isolated and close to the ground surface. Other in-situ or ex-situ technologies for addressing soil contaminated by these RCRA hazardous constituents would likely not be cost competitive with excavation.
- This soil may need to be removed as part of site redevelopment (e.g., for installing foundations). Contaminated soil that is excavated would be replaced with clean fill, thus facilitating redevelopment.

#### **3.6.4.2 VOCs-Contaminated Soil in the Vadose Zone**

The recommended corrective measure for VOCs-contaminated soil in the vadose zone at the Former Chlorobenzene and Benzene Storage Area is SVE. The rationale is as follows:

- The majority of the contaminated soil volume in the vadose zone at this AOC is impacted by VOCs (MCB and benzene) that are generally amenable to recovery by SVE.
- SVE is a proven technology, with relatively low costs compared to other options (e.g., excavation). It can also be quickly implemented using skid-mounted or permanent systems and vertical and/or horizontal extraction wells, and it usually achieves rapid contaminant reductions. It is also relatively simple to incorporate the aboveground components of SVE systems into any new construction plans for the site.
- Like other advection-based technologies, SVE systems tend to approach asymptotic limits in contaminant concentrations over time. However, the ability to use CMOs based on industrial land use at the facility increases the potential that an SVE system would provide adequate reductions of VOCs concentrations in soil.



#### 3.6.4.3 VOCs Contamination in the SHU

The appropriate technology can be selected once the additional groundwater characterization results are obtained.

#### 3.6.5 *Required Actions for Implementation*

The following actions are required prior to, or as the initial phase(s) of, implementing the recommended technologies:

- A conceptual design of the SVE system would need to be prepared. Because of the large volume of VOCs-impacted soil and the heterogeneous stratigraphy of the vadose zone at the facility, it is recommended that a field pilot test be conducted to establish design parameters such as ROI and maximum achievable vacuum. In addition, because of the large areal extent of VOCs impacts at this AOC, the best approach may be two or more independent SVE systems installed in and around “hot spots,” as opposed to a single, interconnected system.
- Appropriate disposal facilities should be located and unit prices obtained for disposal of the SVOCs-, PCBs-, and metals-impacted soil.
- Groundwater quality in the SHU should be evaluated, focusing on the extent of benzene and phenol in the vicinity of the western facility boundary.

### 3.7 **Former North Plant Process Area – Vadose Zone Soil and SHU**

#### 3.7.1 *Description*

The Former North Plant Process Area is located in the north-central portion of the facility. It encompasses approximately 20 acres and is currently inactive. The eastern portion of the North Plant Process Area has been part of the plant process area since 1926. By 1942, the North Plant Process Area had also expanded to the west. Between 1942 and 1961, the entire North Plant Process Area became part of the facility. By 2004, the North Plant Process Area was no longer being used as a chemical processing area [Solutia, 2004a].

The near-surface materials beneath the Former North Plant Process Area consist of fill within the upper two to three feet of soil. The fill is underlain by a heterogeneous mix of silt, sand, and gravel, with occasional thin clay layers, to a depth of at least 16 ft bgs. No borings deeper than 16 ft bgs (the water table) have been advanced at this AOC.



### 3.7.2 *Site Investigation Results*

#### Soil

Soil samples were collected from a total of 14 soil borings advanced in the Former North Plant Process Area as part of the 2003 CMS soil investigation. Soil samples from borings S0408, S0409, and S0426 advanced in this area indicated exceedances of TACO Tier 1 remediation objectives for industrial land use. As part of the August 2005 CMS supplemental soil investigation, soil borings S0430, S0431, S0432, and S0433 were advanced to assess the areal extent of VOCs that exceeded the TACO Tier 1 remediation objectives in the vicinity of S0408 and S0409. Additional soil samples were collected at soil boring S0403 to assess the presence of VOCs and SVOCs.

During these investigations, 2-hexanone (MBK) was detected in soil boring S0403 (depth of ten ft bgs to 12 ft bgs) and in borings S0430 and S0431 (depth of 13 ft bgs to 15 ft bgs) at concentrations up to 2.1 mg/kg. These concentrations exceeded the TACO Tier 1 remediation objectives for the direct contact and soil migration to groundwater pathways. The vertical extent of MBK was not defined in these borings. Other RCRA hazardous constituents detected above TACO Tier 1 remediation objectives for the direct contact pathway included: (1) cis-1,3-dichloropropene, trans-1,3-dichloropropene, and arsenic in boring S08408; (2) arsenic in boring S0409; and (3) BAP in boring S0426.

RCRA hazardous constituents detected above TACO Tier 1 remediation objectives for the soil migration to groundwater pathway (but not above the direct contact criteria) included MCB at concentrations of 90 mg/kg and 8.9 mg/kg in borings S0408 and S0426, respectively, and benzene at a concentration of 0.57 mg/kg in boring S0403.

#### Groundwater

No groundwater monitoring wells were installed in the SHU in the Former North Plant Process Area.

#### Indoor Air

No indoor air sampling was performed at the North Plant Process Area during the 2003 site investigation, because no occupied structures were located in this area. A soil gas sample was collected from one shallow soil boring (SVP-5) located in the northwestern corner of the AOC. The sampling depth interval was from 5.5 ft bgs to six ft bgs. No RCRA hazardous constituents were detected in the soil gas sample.

### 3.7.3 *Technology Evaluation*

For the Former North Plant Process Area, the following candidate technologies were screened, and the results are as follows:

- Excavation and Off-site Disposal (Accepted)



- Capping (Accepted) (note – the area is currently covered with gravel)
- SVE (Accepted)
- Bioventing (Rejected, due to elevated concentrations of MCB and other VOCs; bioventing could potentially be used as a second stage of corrective measures after sufficient contaminant mass is removed)
- Thermal Methods (Rejected, due to high cost; the VOCs detected at this area are readily volatilized under ambient temperature and pressure)
- Phytoremediation (Rejected, due to depth of soil contamination exceeding normal root structure depths).

Threshold Criteria: Capping (replacement of the gravel cap with a more impermeable surface) would prevent or limit direct contact, ingestion, and inhalation exposures and reduce leaching of additional contaminants to groundwater (the seasonal rise and fall of the water table could also contribute to future groundwater contamination, through contact with the smear zone). However, unlike excavation and SVE, capping would not reduce source mass. SVE could remediate VOCs but not the BAP detected in one shallow soil sample. Of the three alternatives, excavation would generate the largest quantity of waste requiring off-site disposal. Excavation and SVE could both produce excess groundwater requiring treatment and discharge to the local sewer system, and ultimately to the American Bottoms WWTP.

Balancing Criteria: All three technologies have proven to be effective and reliable at numerous sites. Excavation would provide the largest degree of contaminant reduction (and greatest certainty that all contamination is removed); however, it would also have the greatest cost. Short-term impacts associated with these technologies include: (1) noise, traffic, and diesel exhaust emissions (excavation and cap construction); (2) fugitive air emissions from soil piles (excavation); and (3) stack air emissions and wastewater generation (SVE). Off-gas treatment using activated carbon canisters or catalytic oxidizers is often required to meet regulatory requirements for emissions from SVE systems. SVE systems can be constructed with off-the-shelf equipment and would require on-site electrical power; excavation would require disposal capacity at an off-site landfill (probably a hazardous waste facility, assuming that the soil contamination was caused by listed hazardous wastes). Furthermore, the contaminated soil would likely require pre-treatment at the disposal facility to meet RCRA LDRs, and the nearest permitted hazardous waste disposal facility may be located some distance from the facility.

#### ***3.7.4 Recommended Technologies and Rationale***

The recommended corrective measures for the Former North Plant Process Area are: (1) SVE to address VOCs contamination in vadose zone soil; (2) excavation of a small volume of near-surface soil impacted by BAP; and (3) risk-based closure of elevated



background arsenic concentrations under TACO, if possible. If risk-based closure for arsenic cannot be achieved, an asphalt or similar impermeable cap may be installed to mitigate direct contact risks. The rationale is as follows:

- The majority of the contaminated soil volume in the vadose zone is impacted by VOCs that are generally amenable to recovery by SVE.
- SVE is a proven technology, with relatively low costs compared to other options (e.g., excavation). It can also be quickly implemented using skid-mounted systems and ordinary vertical or horizontal extraction wells, and usually achieves rapid reductions in VOC concentrations.
- Like other advection-based technologies, SVE systems tend to approach asymptotic limits in contaminant concentrations over time. However, the ability to use industrial CMOs at the facility increases the potential that an SVE system would provide adequate reductions in VOC concentrations.
- The detected BAP is located close to the ground surface and is present within a limited area; hence excavation and off-site disposal would be cost competitive with other technologies for remediation of this portion of the soil volume.

### ***3.7.5 Required Actions for Implementation***

The following actions are required prior to, or as the initial phase(s) of, implementing the recommended technology:

- A conceptual design of the SVE system would need to be prepared. Similar to the other AOCs, a field pilot test at this AOC would be valuable to establish design parameters such as ROI and maximum achievable vacuum.
- Appropriate disposal facilities should be located and unit prices obtained for disposal of the BAP-impacted soil. Because the BAP-impacted soil is located within an area also contaminated with VOCs potentially associated with F- or U-listed wastes, the soil would be classified as RCRA hazardous waste if concentrations of RCRA hazardous constituents are above health-based action levels, such as the TACO Tier 1 remediation objectives.
- An investigation of groundwater quality in the SHU at the Former North Plant Process Area should be performed. The presence of elevated VOC concentrations close to the water table (i.e., at depths of approximately 15 ft bgs) indicates that potential impacts to groundwater need to be assessed.



### **3.8 Former PCBs Warehouse Area – Vadose Zone and SHU**

#### **3.8.1 Description**

The Former PCBs Warehouse Area is located in the central portion of the facility, south of 3<sup>rd</sup> Street and east of G Street. It encompasses approximately 0.4 acres and is currently inactive. The PCBs Warehouse, which has been dismantled, was used to store process wastes from 1977 until 1981/1982 and was identified as an inactive HWMU [Solutia, 2004a].

The near-surface materials in the Former PCBs Warehouse Area consist of fill to a depth of nine ft bgs, underlain by silty sand and silt with occasional silty clay layers to a depth of 16 ft bgs.

#### **3.8.2 Site Investigation Results**

##### Soil

During pre-CMS investigations, a total of 12 borings were advanced and soil samples were collected and analyzed at depths ranging from the ground surface to 16 ft bgs. Total PCBs as Aroclors™ were detected in nine of the 12 soil borings at concentrations up to 9,200 mg/kg (boring B-26). Total PCBs concentrations in three borings located on the east side of the Former PCBs Warehouse Area exceeded 25 mg/kg (i.e., the concentration above which corrective action is required under the TSCA Mega Rule for closure in place of PCBs-impacted soils at “low occupancy” properties [EPA, 1999]). Total VOCs and total SVOCs were also detected at concentrations of 250 mg/kg and 11,200 mg/kg, respectively, in soil boring B-26.

During the 2003 CMS investigation, one soil boring (S0706) was advanced to a depth of 16 ft bgs in the vicinity of the southeast corner of the Former PCB Warehouse Area. Benzene (0.15 mg/kg) and MCB (3.9 mg/kg) were detected in the soil sample collected from 13 ft bgs to 15 ft bgs at concentrations exceeding TACO Tier 1 remediation objectives for industrial soil.

##### Groundwater

No groundwater monitoring wells are installed, and no groundwater sampling has been performed, in the SHU in the Former PCBs Warehouse Area.

#### **3.8.3 Technology Evaluation**

##### **3.8.3.1 PCBs-Contaminated Soil**

The site investigation revealed the presence of PCBs above TSCA action levels in shallow soil directly east of the Former PCBs Warehouse Area. Technologies considered for remediation of this PCBs-contaminated soil included: (1) capping, (2) excavation and



off-site disposal, and (3) in-situ S/S. Remedial measures relying on ex-situ treatment technologies (e.g., thermal desorption, composting, slurry bioreactors) were screened out because of high cost and uncertainty of available land area at the facility. Ex-situ approaches are also more visible to surrounding land owners, thus requiring more time and cost on public relations.

Threshold Criteria: All three technologies would mitigate risks to human health and the environment in the short term; the success of the capping alternative is dependent on long-term (perhaps indefinite) maintenance of the cap. In addition, capping would not provide progress toward attaining media cleanup standards for soil. All three technologies would provide source control: (1) capping would prevent further infiltration and minimize leaching, (2) excavation would remove the contaminated soil, and (3) stabilization would fix the PCBs within the soil matrix. Excavated contaminated soil would need to be disposed in an off-site TSCA landfill; there are very few permitted TSCA landfills in the Midwestern United States, meaning transportation costs would be significant.

Balancing Criteria: All three technologies are reliable and effective and have proven track records for contaminated soils. As discussed in Appendix B, there are a limited number of sites where in-situ S/S has been used to address PCBs, and based on those case histories, there is some doubt as to whether the leachate from stabilized soils would meet the TACO criteria for protection of groundwater. Excavation and off-site disposal would reduce the toxicity, mobility, and volume of contaminated soil at the Former PCB Warehouse Area. In-situ S/S (if proven successful) would reduce the mobility of PCBs, but not necessarily the volume or toxicity. For all three options, potential short-term impacts include noise, air emissions, and traffic associated with excavation and construction equipment. Potential impacts to storm water (on site and off site) would also need to be mitigated through measures such as berms, silt fences, and washing trucks before they leave the site.

All three technologies are implementable, although in-situ S/S would require bench-scale and/or pilot-scale testing before implementation (the costs of which would probably not justify using this technology for the rather small volumes of PCBs-impacted soil at this AOC). While the initial costs associated with installing an impermeable cap above the impacted soil may appear lower than other alternatives, the long-term maintenance, repair, and groundwater monitoring costs would eventually result in a greater life-cycle cost. Note that for concentrations of PCBs above 50 mg/kg in soil (low-occupancy area) or 10 mg/kg (high-occupancy area), any caps installed above the PCBs-impacted soil would have to meet TSCA design specifications, which consist of: (1) ten inches or more of compacted low-permeability soil, or (2) six inches of asphalt or concrete. In addition, TSCA regulations specify that any caps used to address PCBs contamination must remain *in perpetuity* [EPA, 1999].



### 3.8.3.2 VOCs-Contaminated Soil

The VOCs-impacted soil discovered in boring S0706 is located in close proximity to the western edge of the Former Chlorobenzene Process Area AOC (refer to Section 3.2). Therefore, it is assumed that the corrective measures implemented to address the Former Chlorobenzene Process Area would be extended to cover contaminated soil at S0706.

### 3.8.4 *Recommended Technology and Rationale*

The recommended corrective measure for PCBs-contaminated soil at the Former PCBs Warehouse Area is excavation and off-site disposal. The rationale is as follows:

- PCBs contamination is concentrated in one small area east of the former warehouse building and is located at relatively shallow depths (i.e., 15 ft bgs). Other in-situ or ex-situ technologies for addressing PCBs would likely not be cost competitive with excavation and could require a considerable amount of unused on-site space while the remedy is in progress (which could interfere with operations by any new tenants).
- This soil may need to be removed anyway, as part of site redevelopment (e.g., for installing foundations). Contaminated soil would be replaced with clean fill, thus facilitating redevelopment.

### 3.8.5 *Required Actions for Implementation*

The following actions are required prior to, or as the initial phases of, implementing the recommended technology:

- The volume of PCBs-contaminated soil should be estimated, either using existing soil sampling data and/or advancing and sampling additional “step out” borings.
- Appropriate disposal facilities should be located and unit prices obtained for disposal of the PCBs-impacted soil. As noted above, there are a very limited number of TSCA-permitted landfills where PCBs-impacted soil can be disposed; thus, transportation costs could be considerable.
- Groundwater quality in the SHU should be assessed for VOCs, SVOCs, and PCBs in areas where TACO Tier 1 soil remediation objectives for the migration to groundwater pathway have been exceeded. Direct-push borings and temporary wells may be utilized for the initial extent of contamination assessment; however, permanent wells may be required to confirm direct-push data and/or enable longer-term monitoring of any detected groundwater quality issues.



### 3.9 DNT Contamination East of "G" Street

#### 3.9.1 Description

No information was available in the administrative record documents indicating the source or cause of this contamination. However, given Monsanto's manufacture of chemical munitions at the facility during World War II, it is reasonable to suspect a connection between those operations and detections of explosives in soil (refer to Section 3.9.2 below).

#### 3.9.2 Site Investigation Results

##### Soil

One soil boring (S0425) was advanced, and three soil samples were collected and analyzed, at depths ranging from the ground surface to 16 ft bgs. 2,4-DNT and 2,6-DNT were detected in the three soil samples at concentrations up to 0.51 mg/kg and 0.67 mg/kg, respectively. Concentrations of 2,4-DNT and 2,6-DNT exceeded the TACO Tier 1 remediation objectives for industrial soil to a depth of 16 ft bgs.

##### Groundwater

No groundwater sampling was performed at this AOC during prior site investigations.

#### 3.9.3 Technology Evaluation

At this time, it would be premature to select a technology to address the contamination at this AOC. It is necessary to delineate the horizontal and vertical extent of 2,4-DNT and 2,6-DNT in the vadose zone, and also to determine whether these compounds have affected groundwater quality in the SHU.

Both 2,4-DNT and 2,6-DNT are moderately soluble in water and have very low volatility (based on Henry's Law constants), relatively weak affinity for organic carbon, and high persistence in the environment (as measured by first order degradation constants) [IEPA, 2002]. Technologies that have either been pilot tested or used on commercial-scale projects for explosives contamination include:

- Soil: Ex-situ chemical oxidation, incineration, composting, ex-situ bioremediation (slurry reactor), and thermal desorption
- Groundwater: MNA, phytoremediation, activated carbon adsorption, and ultraviolet (UV)-catalyzed chemical oxidation.

The most feasible and cost-effective technology will depend on: (1) the quantity of contaminated soil; (2) concentrations of explosives such as DNT; (3) whether groundwater is impacted, and if so, to what degree; (4) amount of aboveground space



required for ex-situ remedies or phytoremediation; and (5) other factors influencing feasibility and performance (e.g., the geochemical properties of the SHU could dictate the viability and type [aerobic or anaerobic] of in-situ bioremediation options).

### **3.10 Lot F Pipeline Corridor**

#### **3.10.1 Description**

The Pipeline Corridor is located in the northern portion of Lot F. A subterranean pipeline connecting the two on-site benzene storage tanks ("Big Mo" and "Little Mo") to a filling terminal on the Mississippi River bank ran from west to east beneath this portion of Lot F. The terminal also received sulfuric acid, toluene, caustic soda, MCB, and fuel oil. Buried pipelines for these other substances leading to the facility were also present in the Lot F Pipeline Corridor. The river terminal operated from around 1960 into the 1980s (specific dates are not available) [Solutia, 2000].

#### **3.10.2 Site Investigation Results**

##### Soil

During the DNAPL investigation conducted at the facility in April and May 2004, two soil borings (DNAPL-K-9 and DNAPL-K-12) were advanced to bedrock within the Lot F Pipeline Corridor. Soil samples were collected throughout the vertical depth of these borings (generally one sample for every ten-foot vertical depth of soil column) and were analyzed for VOCs and SVOCs. In boring DNAPL-K-9, located at the eastern end of the Pipeline Corridor and just west of Illinois Route 3, benzene and MCB were detected at concentrations exceeding the TACO Tier 1 remediation objectives for industrial soil at depths ranging from 18 ft bgs to 65 ft bgs. The maximum concentrations of benzene and MCB detected in this boring were 15 mg/kg and 37 mg/kg, respectively. In boring DNAPL-K-12, located near the western end of the Pipeline Corridor, benzene concentrations exceeded the TACO Tier 1 remediation objective for industrial soils from 33.5 ft bgs to 68.5 ft bgs. The maximum concentration of benzene detected at this location was 7.2 mg/kg. MCB was also detected at a concentration (3 mg/kg) exceeding the TACO Tier I remediation objectives in the soil sample collected from 53.5 ft bgs to 56 ft bgs.

##### Groundwater

Groundwater in the SHU was not sampled during prior investigations at the Lot F Pipeline Corridor.

#### **3.10.3 Technology Evaluation**

From the types of RCRA hazardous constituents and depths of the exceedances, it appears that the contamination at the Lot F Pipeline Corridor is primarily associated with the MHU and DHU. The recommended corrective measures for the MHU/DHU are



discussed in the following section (Section 3.11). Therefore, it is not necessary to provide a separate evaluation of technologies for contamination within the Lot F Pipeline Corridor.

### 3.11 Groundwater in the MHU and DHU

#### 3.11.1 Description

##### Aquifer Characteristics

The facility is situated in a physiographic region called the American Bottoms. The American Bottoms are underlain by unconsolidated valley fill deposits, which are composed of recent alluvium (Cahokia Alluvium) overlying glacial material of the Henry Formation. These unconsolidated deposits are underlain by Pennsylvanian Age and Mississippian Age limestone and dolomite, with lesser amounts of sandstone and shale. The depth to the top of bedrock varies from approximately 90 ft bgs (in the eastern portion of the facility where the DNAPL source areas have been identified) to approximately 130 ft near the Mississippi River (note that the total depth below ground surface near the River is measured from the top of a 30-foot high levee).

The Cahokia Alluvium consists of unconsolidated, poorly sorted, fine-grained materials with some local sand and clay lenses. The shallower Cahokia Alluvium deposits (i.e., the SHU) are fine-grained silty sand becoming coarser with depth. These deposits are approximately 95 feet thick at the Mississippi River, thinning to about 40 feet thick on the facility property. The underlying Henry Formation consists of approximately 40 feet of coarse-grained glacial outwash deposits composed of medium- to coarse-grained sands becoming coarser with depth. In some areas, till and/or boulder zones are found ten feet to 15 feet above the bedrock surface.

Two types of water-bearing formations exist in the American Bottoms: unconsolidated and consolidated. The unconsolidated formations are those that lie between the ground surface and the bedrock, and these consist predominantly of silt, sand, and gravel materials. Fine-grained sediments generally dominate at the ground surface and become coarser and more permeable with depth; consequently, permeability and porosity both increase with depth.

Site-specific geologic data show that the unconsolidated deposits range from 140 feet thick near the river to about 110 feet thick in the eastern portion of the facility. At most site locations, the contact between the Cahokia Alluvium and the Henry Formation cannot be distinguished. However, three distinct hydrogeologic units can be identified: (1) the SHU; (2) the MHU; and (3) the DHU. The approximately 30-foot thick SHU includes the Cahokia Alluvium and the uppermost portion of the Henry Formation. This unit is primarily unconsolidated, fine-grained silty sand with low to moderate permeabilities. The approximately 40-foot thick MHU is formed by the upper to middle, medium to coarse sand portions of the Henry Formation. It contains higher permeability sand than sands in the overlying SHU, and these sands become coarser with depth. At



the bottom of the MHU is the approximately 40-foot thick DHU, which includes the high permeability, coarse-grained deposits of the lower Henry Formation.

Table 3-10 summarizes the average hydraulic properties of the unconsolidated aquifers, based on ten aquifer tests and 100 specific capacity tests conducted on industrial, municipal, irrigation, and relief wells in the American Bottoms over a span of 30 years.

**Table 3-10: Average Hydraulic Properties of the American Bottoms Aquifer**

Hydrogeologic Unit	Transmissivity (gpd/ft)	Hydraulic Conductivity (cm/sec)	Storage Coefficient (unitless)
SHU	141.5	$4.0 \times 10^{-4}$	Not available
MHU	165,000	$1.6 \times 10^{-1}$	0.04
DHU	211,000	$1.2 \times 10^{-1}$	0.002 to 0.100

gpd/ft – gallons per day per foot of aquifer thickness

cm/sec – centimeters per second

Recharge to the aquifer occurs through four sources: (1) precipitation, (2) infiltration from the Mississippi River, (3) inflow from the buried channel of the Mississippi River, and (4) subsurface flow from the bluffs that border the floodplain on the east. The depth to groundwater beneath the facility varies based on seasonal fluctuations, the location on the site, and the flood stage of the river. In general, the depth varies from less than ten ft bgs to approximately 20 ft bgs. The groundwater flow direction is east to west, with groundwater discharging from the MHU/DHU to the river at an average rate of approximately 250 gallons per minute (gpm) per thousand feet of river frontage. Particle track modeling indicated that the groundwater seepage velocity in the MHU/DHU is approximately 300 feet per year [Solutia, 2004a].

#### Groundwater Interaction with the Mississippi River

The Mississippi River is the major surface water feature draining the area and is located approximately 3,000 feet (0.57 miles) west of the facility at its closest point. A floodwall and levee system, maintained by the U.S. Army Corps of Engineers (USACE) and the Metro East Sanitary District, protects the facility from flooding during high river stage events [Solutia, 2004a]. Lot F is the portion of the facility property closest to the river; it is currently undeveloped, but the northern two-thirds (approximately) of Lot F was recently sold by Solutia for redevelopment [Solutia, 2006g]. The land surface in the area of the facility is very flat, and surface drainage occurs predominantly by infiltration rather than surface runoff. The facility surface is covered by 12 inches of gravel at most locations, which was installed as an engineering control to minimize direct contact with contaminated soil; some areas are paved with concrete or grassed. At the facility, the land surface elevation drops approximately seven feet, with a slight downhill slope, from east to west. Predominant surface drainage patterns are not present in the former manufacturing areas because of a low topographic gradient with little relief.



Drainage and runoff control structures at the facility include diking around AST farm areas and curbing or concrete trenching around former process areas. Stormwater runoff is drained by a combined storm and sanitary sewer system, which ties into the Village of Sauget sewer system and is treated at the American Bottoms WWTP.

In the facility vicinity, the Mississippi River is fed by a complex network of natural and artificial channels, which have undergone extensive improvement throughout the past 80 to 100 years. At least 40 miles of improved drainage ditches were constructed in the American Bottoms area, and the natural lake area in the center of the floodplain was reduced by more than 40 percent during the 20<sup>th</sup> century. Dead Creek, a 17,000-foot long storm-water drainage ditch located approximately 2,000 feet south of the facility, is the nearest channel to the facility property. As discussed above, storm water from the facility does not discharge to Dead Creek, but rather is discharged to the Village of Sauget sewer system. As noted in Section 3.2.1 of this Report, a filled-in segment of the former Dead Creek drainage pathway crosses the facility property from north to south in the Former Chlorobenzene Process Area.

As of August 2004, the highest recorded river stage in the Mississippi River was 429.52 feet above mean sea level (ft MSL), and the lowest recorded stage was 373.74 ft MSL. The elevations of the 100-year and 500-year floods are 427.0 ft MSL and 428.8 ft MSL, respectively, and the top of the floodwall/levee is 431.5 ft MSL. Zero river stage is 379.94 ft MSL [Solutia, 2004a].

### ***3.11.2 Site Investigation Results***

#### **Groundwater Quality in the MHU and DHU**

A considerable amount of groundwater quality data has been collected at the facility and surrounding properties that comprises the SA1 and SA2 CERCLA OUs over the past 15 years. Most of the on-site data was collected from direct-push borings, temporary wells, or piezometers. As one condition of approving Solutia's CMP, EPA requested that a network of permanent monitoring wells be constructed to enable long-term monitoring of the plume of VOCs, SVOCs, and PCBs on the facility and downgradient properties between Lot F and the River; this has been labeled the Plume Stability Monitoring Network. This network presently consists of 20 wells screened at depth intervals in the MHU or DHU that have historically shown the greatest impact of dissolved-phase organic constituents. Table 3-11 summarizes the Plume Stability Monitoring Network well construction details [Solutia, 2006h].



Table 3-11: Monitoring Well Completion Summary, Plume Stability Monitoring Network

Well ID	Total Depth (ft bgs)	Screened Interval (ft bgs)	Screen Length (ft)	Construction Material	Well Diameter (inches)	Date Installed	Top of Casing Elevation (ft NAVD)	Riser Height (ft ags)
PSMW-1	42.78	37.78 – 42.78	5	Stainless steel	2	10/19/2005	412.59	3.22
PSMW-2	73.84	68.84 – 73.84	5	Stainless steel	2	10/25/2005	410.88	-0.34
PSMW-3	71.12	66.12 – 71.12	5	Stainless steel	2	10/20/2005	408.32	-0.30
PSMW-4	104.96	99.96 – 104.96	5	Stainless steel	2	10/24/2005	408.20	-0.31
PSMW-5	24.68	19.68 – 24.68	5	Stainless steel	2	10/20/2005	412.31	2.82
PSMW-6	107.32	102.32 – 107.32	5	Stainless steel	2	3/8/2006	406.63	2.52
PSMW-7	109.95	104.95 – 109.95	5	Stainless steel	2	10/17/2005	412.31	3.05
PSMW-8	73.92	68.92 – 73.92	5	Stainless steel	2	10/18/2005	415.13	3.13
PSMW-9	105.40	100.40 – 105.40	5	Stainless steel	2	3/7/2006	403.52	-0.40
PSMW-10	108.78	103.78 – 108.78	5	Stainless steel	2	6/5-6/6/2006	412.18	2.55
PSMW-11	121.44	116.44 – 121.44	5	Stainless steel	2	6/13/2006	421.20	-0.37
PSMW-12	112.02	107.02 – 112.02	5	Stainless steel	2	3/10/2006	415.74	2.83
PSMW-13	111.08	106.08 – 111.08	5	Stainless steel	2	3/13/2006	405.53	-0.27
PSMW-14M	47.50	42.50 – 47.50	5	Stainless steel	2	6/7/2006	412.98	2.14
PSMW-14D	112.63	107.63 – 112.63	5	Stainless steel	2	6/6/2006	413.15	2.12
PSMW-15M	55.78	50.78 – 55.78	5	Stainless steel	2	6/12/2006	419.03	-0.50
PSMW-15D	122.12	117.12 – 122.12	5	Stainless steel	2	6/12/2006	419.54	-0.31
PSMW-16M	63.49	58.49 – 63.49	5	Stainless steel	2	6/8/2006	424.73	-0.27
PSMW-16D	123.54	118.54 – 123.54	5	Stainless steel	2	6/7-6/8/2006	424.69	-0.31
PSMW-17	129.50	119.50 – 129.50	10	Stainless steel	2	6/17/2006	423.26	3.25

ft ags – feet above ground surface; NAVD – North American Vertical Datum

Note: Riser heights are above ground surface (positive values) or below ground surface (negative values).



Figure 2 of Solutia [2006h] shows the well locations. The Plume Stability Monitoring Network Wells were installed between October 2005 and June 2006 and have been sampled in March 2006 (First Quarter 2006 Event) and June 2006 (Second Quarter 2006 Event). For brevity, the discussion in this section is based on the groundwater data collected from the Plume Stability Monitoring Network wells during these two recent sampling events.

The key analytical results from the First Quarter and Second Quarter 2006 groundwater sampling events are displayed in Table 3-12. Note that monitoring wells PSMW-10, PSMW-11, PSMW-14M, PSMW-14D, PSMW-15M, PSMW-15D, PSMW-16M, PSMW-16D, and PSMW-17 were not installed in time to be sampled during the First Quarter 2006 event because they are on off-site properties and site access was not provided to Solutia until early in 2006 [Solutia, 2006a and 2006i].

**Table 3-12: Exceedances of TACO Tier 1, Class I Remediation Objectives for Organic RCRA Hazardous Constituents, Plume Stability Groundwater Monitoring Network**

Monitoring Well	Location	COCs Above Tier 1, Class I ROs	Detected Concentrations (µg/L)	
			First Quarter (March 2006)	Second Quarter (June 2006)
PSMW-1	Northern Plume Boundary	Ethylbenzene <sup>a</sup>	1,500	1,500
		Benzene	3,700	3,900
		Naphthalene	180	180
PSMW-2	Former PCBs Manufacturing Area	Total PCBs <sup>b</sup>	0.16	0.34
		Benzene	3,200	3,700
		MCB	790	520
		p-Chloroaniline	87	48
PSMW-3	Former Chlorobenzene Process Area (CPA)	1,2-DCB	39,000	21,000
		1,3-DCB <sup>c</sup>	2,400	1,200
		1,4-DCB	20,000	11,000
		Benzene	6,500	2,900
		MCB	24,000	16,000
		p-Chloroaniline	380	370
		1,2,4-TCB	1,500	850
		2-Chlorophenol	NE	38
		PCP	NE	55
		Total PCBs	48.5	49.6
PSMW-4	North Tank Farm	1,2-DCB	1,200	710
		1,3-DCB	370	350
		1,4-DCB	8,400	6,400
		Benzene	1,600	2,200
		MCB	30,000	32,000
		p-Chloroaniline	69	55
		Total PCBs	NE	0.53
PSMW-5	Former Chlorobenzene Storage Area (CSA)	Benzene	490,000	880,000
		Phenol	140	NE
PSMW-6	Northern Plume Boundary	Benzene	6	8.8
		MCB	210	310
PSMW-7	CPA Migration Pathway	1,4-DCB	550	NE
		Benzene	11,000	580
		MCB	1,400	320
		p-Chloroaniline	250	180
		Phenol	170	NE
PSMW-8	CSA Migration Pathway	1,4-DCB	100	NE
		Benzene	11,000	1,900
		MCB	2,100	1,700



**Table 3-12: Exceedances of TACO Tier 1, Class I Remediation Objectives for Organic RCRA Hazardous Constituents, Plume Stability Groundwater Monitoring Network**

Monitoring Well	Location	COCs Above Tier 1, Class I ROs	Detected Concentrations (µg/L)	
			First Quarter (March 2006)	Second Quarter (June 2006)
PSMW-11	CPA Migration Pathway	Vinyl Chloride	NE	4.2
		2-Chlorophenol	NE	96
		Benzene	NI	73
		MCB	NI	1,400
		p-Chloroaniline	NI	240
PSMW-12	CSA Migration Pathway	1,4-DCB	520	520
		Benzene	63	53
		MCB	NE	1,400
		Vinyl chloride	58	35
		n-Nitrosodiphenylamine	11	NE
		Total PCBs	16.2	26.97
		Heptachlor	NE	0.37
PSMW-14D	Northern Plume	MCB	NI	1,200
PSMW-15D	CPA Migration Pathway	Benzene	NI	6,800
		MCB	NI	1,300
		Phenol	NI	140
PSMW-16D	CSA Migration Pathway	1,4-DCB	NI	90
		Benzene	NI	53
		MCB	NI	2,300
		Vinyl Chloride	NI	13
PSMW-17	Southern Plume Boundary	1,2-DCB	NI	5,700
		1,4-DCB	NI	170
		MCB	NI	920
		p-Chloroaniline	NI	7,600
		1,2,4-Trichlorobenzene	NI	180

- A bulk fuels terminal is located upgradient from the facility, which could explain the detections of petroleum hydrocarbons in this well.
  - Analysis for total PCBs was by EPA Method 680 (homologs). The TACO regulations do not contain remediation objectives for individual PCB homologs. The remediation objective for Total PCBs in Class I groundwater is 0.5 µg/L.
  - There are no remediation objectives for 1,3-DCB in the TACO regulations.
- NE – Compound (if detected) did not exceed the corresponding TACO standard  
NI – Well was not installed in time to be sampled during the First Quarter 2006 sampling event.

In addition, total barium, total vanadium, and total zinc were each detected at or slightly above the respective Tier 1, Class I remediation objectives at several Plume Stability Monitoring Network wells. Based on the available information regarding historical



operations at the facility and regional geologic conditions, these low concentrations of metals are likely due to background conditions.

During the Second Quarter 2006 sampling event, groundwater samples were collected and in-field measurements were made of key parameters used to predict the potential effectiveness of MNA. The following plume stability monitoring network wells were used in this study: PSMW-3, PSMW-5, PSMW-7, PSMW-8, PSMW-11, PSMW-12, PSMW-15M, PSMW-15D, PSMW-16M, and PSMW-16D. Briefly, the observed data were as follows:

- Dissolved oxygen (DO): 0.32 milligrams per liter (mg/L) to 1.01 mg/L
- Oxidation-reduction potential (ORP): -75.6 millivolts (mV) to -151.6 mV
- Ferrous iron (Fe II): zero parts per million (ppm) to off-scale readings (most field test kits can detect ferrous iron up to approximately 20 ppm)
- Alkalinity: 490 mg/L to 1,200 mg/L
- CO<sub>2</sub>: 1.3 mg/L to 120 mg/L
- Chlorides (total): 70 mg/L to 410 mg/L
- Methane: 21 µg/L to 17,000 µg/L
- Sulfate (as SO<sub>4</sub><sup>-</sup>): 12 mg/L to 370 mg/L
- Total organic carbon (TOC): 2.9 mg/L to 16 mg/L.

Until at least one year (i.e., four quarters) of monitoring data of the above parameters are obtained, the ability of the MHU/DHU to maintain geochemical conditions that certain remediation technologies (e.g., MNA, enhanced bioremediation) depend on cannot be assessed. Based on these initial results, it appears that the aquifer is moderately anaerobic, probably in the iron-reducing range (i.e., the range of ORP values where the primary metabolic activity is from iron-reducing bacteria).

#### Surface Water and Sediment in the Mississippi River

Numerous investigations of surface water and sediment in the river north, south, and alongside the downgradient Site R (part of the CERCLA SA2 OU) have been conducted. The southern component of the groundwater plume originating at the facility flows beneath Site R, a former hazardous waste landfill where chlorobenzene and other wastes were allegedly disposed; thus, identification of the source of contaminants detected in the river is problematic. To date, however, there are no conclusive investigation results that rule out the possibility groundwater contamination from the facility has migrated into the river. Therefore, the river is considered to be an AOC associated with the RCRA corrective action as well as with Site R.

Extensive investigations were conducted in the river by both Solutia and EPA in October and November 2000. Briefly, the results were as follows [Solutia, 2004a]:



- Sediment: Constituents detected at elevated concentrations in sediment during one or more investigations included: MCB; benzene; ethylbenzene; toluene; xylenes (total); acetone; carbon disulfide; chloroethane; 1,2-dichloroethane (DCA); cis-1,2-DCE; trans-1,2-DCE; TCE; PCE; methylene chloride; chloroform; methyl ethyl ketone (MEK); methyl isobutyl ketone (MIBK); 4-chloroaniline; 1,2-DCB; 1,4-DCB; 4-bromomethyl ether; phenol; 2-chlorophenol; 2,4-dichlorophenol; 2,4,6-trichlorophenol; PCP; 3/4-methylphenol; 2,4-dimethylphenol; naphthalene; 2-nitroaniline; 2,4-DNT; 4,4'-DDD; 2,4-D; dichloroprop; 2-(4-chloro-2-methylphenoxy)-propanoic acid; dioxin toxicity equivalent (TEQ); aniline; 3-methylphenol; and PCBs (total).
- Surface water: Constituents detected at elevated concentrations in surface water during one or more investigations included: MCB; benzene; ethylbenzene; toluene; xylenes (total); 1,2-DCA; TCE; MIBK; 1,2-DCB; 1,2,4-TCB; 4-chloroaniline; 2-chlorophenol; 2,4-dichlorophenol; 2,4,6-trichlorophenol; PCP; 3/4-methylphenol; 2,4-dimethylphenol; nitrobenzene; bis(2-ethylhexyl)phthalate; di-n-butylphthalate; 2,4,5-TP (Silvex); dicamba; dichloroprop; and dioxin TEQ.
- Fish tissue (whole body—bottom feeders, foragers, and predators): Constituents detected in fish tissue included: 1,2-DCB; 1,4-DCB; 2,4-dichlorophenol; 2-methylphenol; 4,4'-DDD; 4,4'-DDE; 4,4'-DDT; alpha-BHC; alpha-chlordane; gamma-chlordane; dieldrin; endosulfan I; endrin; endrin aldehyde; heptachlor epoxide; 2,4,5-T; Silvex; and 2-(4-chloro-2-methylphenoxy)-propanoic acid.
- Bioassay, sediment: Positive toxicity findings were: fathead minnow (six locations); and hyallela (one location).
- Bioassay, surface water: Positive toxicity findings were: cerodaphnia (11 locations).

In October 2005, Booz Allen, under contract to EPA, collected 31 shallow (7.5 ft bgs or less) sediment samples at various locations upstream and downstream from the plume's probable points of entry into the river. Bank samples were collected using direct-push Geoprobe™ equipment, and underwater samples were collected from a boat using a Vibracore™ device. The samples were analyzed by the EPA Central Regional Laboratory or by Severn-Trent Laboratories, Inc., for the following constituents of concern: VOCs, SVOCs, chlorinated herbicides, chlorinated pesticides, and PCBs (Aroclors™). Detected concentrations were compared to the EPA Region 9 PRGs and to the EPA Region 5 ESLs. Key results are shown in Table 3-13 [Booz Allen, 2006]:



**Table 3-13: Key Results of October 2005 Sediment Sampling in Mississippi River**

Sample Number	Location	RCRA Hazardous Constituents of Interest	Detected Concentrations (µg/kg)
S-01	Background sample, 8.5 miles upstream from Site R at River Mile (RM) 185.5	BAP (PRG, ESL)	705
S-26	Seven miles downstream from Site R at RM 170.0	Heptachlor epoxide (ESL)	28
		4,4'-DDD (ESL)	162
		4,4'-DDT (ESL)	7.39
		PCB-1016 (ESL)	128
		PCB-1260 (PRG, ESL)	229
		1,4-DCB	9.48
S-24	9.75 miles downstream from Site R at RM 167.25, within Jefferson Barracks Chute	Heptachlor epoxide (ESL)	5.27
		4,4'-DDD (ESL)	23.3
		4,4'-DDT (ESL)	9.55
		PCB-1016 (ESL)	148
		PCB-1260 (ESL)	193
		1,4-DCB	8.34

BAP (PRG, ESL) – Concentration was above both the PRG and the ESL.

Heptachlor epoxide (ESL) – Concentration was below the PRG and above the ESL.

1,4-DCB – Concentration was below the PRG and the ESL.

### 3.11.3 GMCS

On September 30, 2002, EPA issued a Unilateral Administrative Order (UAO) for Remedial Design and Interim Remedial Action, Docket V-W-'02-C-716, under Section 106(a) of CERCLA. The UAO required preparation of a remedial design for the SA2 OU Interim Groundwater Remedy, as described in the September 30, 2002, Record of Decision (ROD). The UAO also required implementation of the selected design. Solutia was the only potentially responsible party (PRP) responsive to the UAO.

The remedy selected in the ROD (Remedial Alternative B – Physical Barrier) included installation of a 3,300-foot long, “U”-shaped, fully-penetrating barrier between the downgradient boundary of SA 2 Site R and the Mississippi River, to abate the release of impacted groundwater, both from Site R and from upgradient sites, including the facility. (“Fully-penetrating” means that the barrier, a concrete slurry wall, is installed to the top of the limestone/dolomite bedrock, thus isolating the entire thickness of the MHU/DHU from the river). Three partially-penetrating groundwater recovery wells were also installed inside (upgradient from) the barrier to control hydraulic heads across the barrier thickness, thus preventing excessive stresses on the barrier. The pumping rates are correlated to the river stage (i.e., the lower the stage, the greater the pumping rate



required to equilibrate hydraulic heads on both sides of the barrier) and are up to 1,900 gpm per well, at a river stage of 374 ft MSL.

Solutia submitted the Pre-Final Design for the SA 2 GMCS to EPA on January 21, 2003. To facilitate completion of the GMCS, Solutia proceeded with construction of the groundwater extraction system (i.e., the three pumping wells and a force main) at its own risk prior to EPA approval. Construction of the groundwater extraction system began in November 2002 and was completed in June 2003. A permanent 20-inch force main was constructed in May-July 2003 to convey and discharge recovered groundwater to the American Bottoms WWTP [Solutia, 2004a].

Construction of the slurry wall barrier began in September 2003 and was completed in November 2004. The barrier was installed using the slurry trench excavation method, through an approximately eight-foot wide trench. A long-arm backhoe was used to excavate the first 70 feet of soil, and the excavation was completed to its final depth of approximately 140 ft bgs using a clamshell bucket attached to a crane by a metal cable. A bentonite slurry was utilized to support the excavation sidewalls during installation of the barrier. One issue indicated by site construction personnel during the August 2004 site visit was the difficulty in matching the static water level maintained inside the barrier (i.e., by the pumping wells) to the rapidly-changing river stage—a hydraulic gradient of up to five feet across the barrier is common [Yare and Smith, 2004].

As illustrated in Figure 5.4.6 of Solutia [2004a], the GMCS intercepts approximately the southern 40 percent of the plume migrating from the facility.

#### **3.11.4 Bench-Scale Test**

During the period September 2005 to December 2005, Solutia conducted a bench-scale test of the EABR technology on a sample of soil collected from the MHU in the Former Chlorobenzene Process Area. The sample was collected near the location of boring DNAPL-K-3, from a depth interval of 44.5 ft bgs to 48.5 ft bgs. The test procedures used were generally identical to those employed during the bench-scale test of SHU soil from the same area described in Section 3.2.3 of this Report. The soil was loaded into seven test columns, one of which was a control column. The control column was sterilized using a biocide, and nitrogen gas was bubbled through instead of oxygen. Soil samples from the front (upstream), middle, and end (downstream) portions of each column were analyzed to evaluate potentially different levels of treatment and oxygenation along each column length. Effluent samples were collected and analyzed on a weekly basis. The time interval of the test, not including the startup and equilibration procedures, was 12 weeks [Solutia, 2006j].

The EABR bench-scale test attempted to demonstrate mass removal of MCB and DCBs and to validate that any observed mass removal was due to biological degradation processes. To that end, the testing laboratory (Rice University) attempted to develop three lines of evidence:



- Reduction in the total masses of MCB and DCBs (demonstrated through reductions in soil sample concentrations before and after treatment) and reduction in column effluent concentrations over time in the treated columns
- Significant growth in bacterial populations and key enzymes believed to be essential for biodegradation of chlorobenzenes in the treated columns
- Absence of similar mass reductions, effluent contaminant reductions, and growth in bacterial populations and key enzymes in the control (untreated) column.

In general, examination of the EABR bench-scale test results indicated that some lines of evidence were validated, which would suggest that EABR could be a viable technology to treat MCB and DCBs in the MHU. However, several of the test results were inconclusive or unusual, particularly those from the control column. The positive indicators for EABR and the uncertainties can be summarized as follows:

- Reduction in Total MCB and DCBs Mass. MCB mass reductions in the middle and front portions of the treated columns ranged between 80 percent and 100 percent for all tests. In addition, for test intervals longer than six weeks, nearly 100 percent of the MCB mass appeared to have been destroyed. Reduction in MCB mass in the end portions of the treated columns took longer to develop, but at eight weeks and longer, greater than 90 percent of the mass appeared to be destroyed. This result was not unexpected, given that much of the injected oxygen was likely consumed in the upstream portions of the columns, thus requiring longer time intervals for the oxygen-saturated water front to reach the end portions of the columns. The reductions in mass of total DCBs in the front and middle sections of the treated columns were similar to those for MCB (i.e., 90 percent or greater appeared to be destroyed after six weeks of treatment). However, the results for the end sections were less impressive. For example, the ten-week soil concentrations of 1,2-DCB and 1,4-DCB actually increased, possibly due to DCBs desorbing from the front and middle sections of the columns and then becoming readsorbed by the soil within the end sections of the columns. The 12-week mass removals, though better, were also inconsistent and low, ranging from approximately 45 percent to 65 percent.
- Growth in Bacterial Populations and Enzymes. Based on the tests performed (i.e., total plate counts and real-time quantitative polymerase chain reaction [RTQ-PCR] tests), the quantities of total bacteria and most key enzymes appeared to increase significantly in the treated columns, as compared to the untreated soil. Total bacterial populations increased by between one and two orders of magnitude, and all enzymes except toluene di-oxygenase exhibited increases of similar or greater proportions. However, the concentrations of bacteria and enzymes also increased significantly in the control sample, possibly due to inadequate application of biocide. This occurrence affected the results for the control column, as discussed in the following bullet.



- **Control Column Results.** The control column did not produce the desired results, in terms of showing an absence of substantial MCB and DCBs removal in contrast to the treated columns. MCB reductions in the front and middle portions of the column were essentially identical to the treated columns (over 95 percent decreases in soil concentrations), and MCB reduction in the end portion was also substantial (approximately 70 percent). Total DCBs reductions in the front and middle portions ranged between 80 percent and 100 percent, while concentrations of all DCB isomers in the end portion increased substantially relative to the initial soil concentrations (again, possibly due to desorption, transport, and readsorption/accumulation of DCBs within the end-section soil). Furthermore, as mentioned earlier, total bacteria and enzymes appeared to increase significantly in the control column, although not to the degree noted in the treated columns. The EABR Bench Test Report [Solutia, 2006j] attributed these findings to inadequate distribution of biocide within the control column, leading to substantial biological activity and degradation unintentionally occurring within the control sample. While this is a plausible explanation, the absence of robust control data removes an important line of evidence for the EABR bench-scale tests.

Another source of potentially significant error was related to the spiking of MCB and DCBs into the test samples. Because the verification analyses performed to assess baseline concentrations were significantly below the in-field sample results during the DNAPL investigation, Solutia (with EPA's concurrence) spiked the test samples with pre-determined amounts of laboratory-grade MCB and DCBs. Under the circumstances, the spiking was the most reasonable option to attempt to duplicate the historical high concentrations detected at the Former Chlorobenzene Process Area. However, freshly-spiked MCB and DCBs are typically much easier to attenuate than weathered or organic-bound MCB/DCBs, because there is insufficient time for them to equilibrate with the soil matrix and form DNAPL globules. Thus, more of the mass will tend to be captured temporarily on soil sorption sites, where it can be readily desorbed and flushed from the matrix. Moreover, the pre-test homogenization process used during the treatability tests, while advantageous for promoting uniformity of the different sample aliquots, also tends to break down the soil matrix structure and prevent formation of DNAPL globules. The influence of sorption/desorption and flushing on the bench-scale test results could have been considerable. During the first two weeks of the tests, before biological activity was stimulated through the addition of oxygen, an estimated 211 mg of MCB was potentially removed from the test column via flushing. This constituted approximately 45 percent of the total initial MCB mass of 473 mg [EPA, 2006a].

### ***3.11.5 Technology Evaluation***

For MHU and DHU groundwater, the following candidate technologies were screened, and the results are as follows:

- MNA (Accepted)



- Pump and Treat (Rejected, due to disappointing outcomes at many sites, where very large volumes of groundwater have been extracted but little contaminant mass recovered)
- Phytoremediation (Rejected, due to depth of groundwater contamination and shortage of available site area to cultivate trees, which can serve as “natural” pump-and-treat units)
- Enhanced Aerobic Bioremediation (Accepted)
- Enhanced Anaerobic Bioremediation (Accepted)
- Chemical Reductive Dechlorination using Nano-Scale ZVI Injections or a PRB Configuration (Rejected, due to lack of data confirming these technologies are effective on chlorobenzenes and because a PRB would duplicate the existing GMCS)
- ISTD or other Thermal Methods (Rejected, due to prohibitively high costs for treating dissolved-phase contamination)
- Surfactant or Co-Solvent Flushing (Rejected, due to inability to treat dissolved phase contamination)
- MPE (Rejected, due to inability to increase mass recovery appreciably [in high-transmissivity aquifers, MPE tends to function as an expensive pump-and-treat system])
- Air Sparging (Rejected, due to overburden low-permeability soils in the SHU that would limit capture of and/or laterally spread sparged VOCs).

Threshold Criteria: MNA relies primarily on intrinsic bioremediation (aerobic or anaerobic) to achieve progress toward cleanup goals; therefore, one of the two bioremediation approaches would likely promote faster reductions in contaminant concentrations. None of the three accepted technologies aids in controlling the source; in fact, all three would be dependent on the selected DNAPL source control measures to perform effectively. To ensure protectiveness of the Mississippi River, long-term operation of the GMCS would be required under any of these alternatives. All three technologies are in-situ approaches, and would not generate significant quantities of waste requiring management.

Balancing Criteria: MNA alone may or may not be effective and reliable in the long-term, and would depend on initial contaminant concentrations and the ability of the aquifer to sustain natural biodegradation processes. Enhanced aerobic or anaerobic methods, as applicable, would probably accelerate contaminant degradation or transformation, through addition of electron acceptors (e.g., oxygen) for aerobic processes or electron donors (e.g., a carbon source) for anaerobic processes. Geochemical parameters measured or analyzed at the Plume Stability Monitoring



Network wells in June 2006 suggested that portions of the aquifer are moderately anaerobic; thus, an enhanced anaerobic process may be more feasible (as opposed to trying to reverse the aquifer poise to aerobic conditions). However, the anaerobic degradation pathways for chlorobenzenes (and the conditions required to sustain them) are much less well understood than aerobic processes [Wünsch et al., 1999]. None of these technologies would have significant short-term impacts on facility operations or the site environment. Implementation would be relatively straightforward, although any injection of reagents to stimulate biodegradation processes would likely require a permit or permit waiver from the IEPA. All three technologies tend to be relatively low on the cost scale; however, if repeated reagent injections are required, the costs for enhanced bioremediation technologies can approach those associated with more equipment-intensive technologies.

### ***3.11.6 Recommended Technologies and Rationale***

Of the available technologies, enhanced bioremediation methods appear to offer the most significant potential based on sparse data. The most critical element of the MHU/DHU remedy is achieving adequate control at the source areas, thus reducing the quantity of contaminants that must be managed once released into the aquifer. The recommended corrective measures for groundwater in the MHU and DHU are: (1) continued operation of the GMCS; and (2) utilization of MNA in the northern portion of the plume, unless unacceptable discharges to the Mississippi River surface water and sediment are confirmed. If controls are required for the northern portion of the plume, the recommended technology is enhanced aerobic or anaerobic bioremediation, with the appropriate method being determined through additional groundwater sampling and pilot-scale testing. The rationale is as follows:

- The GMCS is necessary in the short term to prevent continued contamination of the river, while source remediation measures are undertaken at the facility (the GMCS also may be required for a longer time to control contaminant migration from the Site R disposal area). However, it is expected that at some point in the future, the GMCS could either begin to deteriorate or it could become too costly to continue O&M on the system. Therefore, a supplemental, contingent technology or program for aqueous-phase contamination in the MHU/DHU is recommended, consisting of either MNA or enhanced bioremediation (see next bullet).
- It is worthwhile to investigate whether MNA is feasible, particularly in the portion of the plume already captured by the GMCS. This investigation will require at least two years of specific monitoring activities, as discussed in Section 3.11.7 below. For the portion of the plume currently discharging to the river north of Site R, an evaluation must be performed to determine whether natural attenuation is sufficient to prevent exceedances of risk-based action levels for surface water and sediment in the river. At a minimum, this consists of continued sampling and analysis of sediment and surface water (refer to Section 3.11.7) and might also include fate-and-transport modeling for contaminated groundwater inside the plume.



- If MNA is found to be inadequate to effectively remove residual contaminant mass in the MHU/DHU after reduction of the source areas, a technology such as enhanced bioremediation (aerobic or anaerobic) could be required.

All three technologies would have minimal impact on aboveground site operations and on groundwater quality and hydraulic properties of the MHU/DHU. In addition, several different approaches/reagents are available for creating aerobic or anaerobic reactive zones in an aquifer, thus providing multiple options and an opportunity to optimize the delivery technique in terms of cost and other factors. All three technologies are compatible with operation of the recommended source remediation technologies and the existing GMCS.

### ***3.11.7 Required Actions for Implementation***

#### **Conduct MNA Investigation**

EPA [1997] references three lines of evidence, in descending order of usefulness, that may be proposed in order to demonstrate the efficacy of MNA as a remediation approach:

- Historical groundwater and/or soil chemistry data that demonstrate a clear and meaningful trend of decreasing contaminant mass and/or concentrations over time at appropriate monitoring or sampling points
- Hydrogeologic and geochemical data that can be used to demonstrate indirectly the type(s) of natural attenuation processes active at the site and the rate at which such processes will reduce contaminant concentrations to required levels
- Data from field and/or microcosm studies (conducted in or with actual contaminated site media) that directly demonstrate the occurrence of biodegradation processes at the site.

In accordance with the requirements of the above-listed lines of evidence, Solutia should prepared a work plan for conducting a detailed evaluation of the feasibility of MNA, in both the portion of the plume captured by the GMCS and the portion presently discharging to the Mississippi River. The goals of this investigation should be as follows:

- Establish a sufficiently comprehensive three-dimensional monitoring network to characterize groundwater flow patterns and fate and transport of the contaminants and daughter compounds in the aquifer of concern
- Derive site-specific degradation rates for site-related contaminants and estimated time to cleanup, based on the compound with the longest half-life



- Monitor all key geochemical parameters (DO, ORP, total and dissolved iron and manganese, nitrates, sulfates, methane, total and dissolved organic carbon, total chlorides, and CO<sub>2</sub>)
- Establish that mineralization or conversion of the contaminants of concern to chloride ions, carbon dioxide, and/or other innocuous compounds is occurring on a sufficiently substantial scale
- Conduct analytical and/or numerical modeling, as necessary and appropriate, to support conclusions regarding the efficacy of MNA
- Ensure that existing groundwater quality will not be adversely impacted and that the required reactions are not inhibited by aquifer conditions (e.g., DNAPL, heavy metals).

EPA approval for using MNA as the remedy for the portion of the plume north of the GMCS should also be contingent on sediment and surface water concentrations of RCRA hazardous constituents (and constituents from the CERCLA OUs) remaining below risk-based standards in the portion of the Mississippi River adjacent to that area of the plume [EPA, 2004c]. Solutia is already conducting periodic sediment and surface water sampling adjacent to Site R as part of the SA2 OU remedial action under CERCLA. This program may need to be expanded to ensure that adequate information regarding potential contamination in the river is being regularly collected and is being correlated with groundwater data from the northern portion of the plume.

At a minimum, eight quarterly sampling events must be conducted, following which an MNA feasibility report would be prepared and submitted to EPA for review. The geochemical data collected during the June 2006 sampling event at the Plume Stability Network monitoring wells may be used as baseline data; however, the potential need for additional monitoring wells and baseline data cannot be ruled out. The feasibility report should recommend whether continued quarterly sampling is necessary to monitor plume behavior or whether a less-frequent monitoring schedule could be adopted. Therefore, the next step for Solutia is to prepare a work plan: (1) describing how the existing Plume Stability Monitoring Network would be used as part of an MNA program; (2) specifying any additional monitoring wells required to complete the network; and (3) containing a field sampling plan (FSP) and quality assurance project plan (QAPP) for the MNA monitoring activities. (Existing FSP or QAPP documents for the site could be utilized if they sufficiently cover the required MNA monitoring activities).

#### Conduct Additional Bioremediation Bench-Scale Tests and/or Field Pilot-Scale Test

As discussed in Section 3.11.4, there were some unresolved areas of uncertainty from the first round of bench-scale tests on MHU soil materials, mostly centered around the unanticipated amount of contaminant degradation in the control column soil. Solutia may choose to address these discrepancies through additional laboratory bench-scale tests and/or could proceed directly to a field pilot-scale test to evaluate bioremediation rates

under actual site conditions. On August 31, 2006, Solutia submitted a work plan for an EABR field pilot-scale test on groundwater in the MHU/DHU. EPA provided technical comments on the draft work plan to Solutia on October 31, 2006. The final conditions and parameters for this pilot test are still under discussion between EPA and Solutia.



#### 4.0 SUMMARY OF RECOMMENDED CORRECTIVE MEASURES

Based on the evaluation of technologies conducted and presented in Section 3, Table 4-1 summarizes the recommended corrective measures for AOCs at the facility.

**Table 4-1: Recommended Corrective Measures for the W.G. Krummrich Facility**

AOC	RCRA Hazardous Constituents	Recommended Corrective Measures
Former PCBs Manufacturing Area <sup>1</sup>	VOCs, SVOCs, and PCBs in the vadose zone (includes PCB DNAPLs)	ISTD
	VOCs, SVOCs, and PCBs in the SHU and MHU (includes PCB DNAPLs)	
Former Chlorobenzene Process Area	VOCs and SVOCs in the vadose zone (includes MCB and DCBs DNAPLs)	ISTD
	VOCs and SVOCs in the SHU (includes MCB and DCBs DNAPLs)	
Former Chlor-Alkali Production Area <sup>2</sup>	Mercury in the vadose zone	Excavation and off-site disposal
	VOCs and SVOCs in the vadose zone	
Former Lot F Drum Disposal Area	Buried waste materials (drum remnants)	Maintain existing cap and MNA; Investigate groundwater and determine any necessary corrective measures
	SVOCs in the SHU	
Central Plant Process Area <sup>2</sup>	VOCs in the vadose zone	SVE
	Metals in the vadose zone	Excavation and off-site disposal
Former Chlorobenzene and Benzene Storage Area	SVOCs, PCBs, and metals in the vadose zone	Excavation and off-site disposal
	VOCs in the vadose zone	SVE
	VOCs and SVOCs in the SHU	Not possible to select a technology at this time, pending further characterization of groundwater quality



**Table 4-1: Recommended Corrective Measures for the W.G. Krummrich Facility**

AOC	RCRA Hazardous Constituents	Recommended Corrective Measures
Former North Plant Process Area <sup>2</sup>	VOCs in the vadose zone	SVE
	BAP in the vadose zone	Excavation and off-site disposal
Former PCB Warehouse Area <sup>2</sup>	PCBs in the vadose zone	Excavation and off-site disposal
DNT Contamination South of "G" Street <sup>2</sup>	2,4-DNT and 2,6-DNT in the vadose zone	Not possible to select a technology at this time, pending further characterization of soil and groundwater quality
Lot F Pipeline Corridor	VOCs in the MHU	Will be addressed at part of the corrective measures for the MHU and DHU (see below)
Groundwater in the MHU and DHU	VOCs, SVOCs, and PCBs in groundwater	MNA <sup>3</sup>
	VOCs, SVOCs, PCBs, pesticides, and herbicides in Mississippi River sediment and surface water	Continued operation of the GMCS at Site R and MNA

1. For all AOCs except Groundwater in the MHU and DHU and the Former PCBs Manufacturing Area, the stated remedy applies to the vadose zone soils and the SHU. The MHU is also addressed above for the Former PCBs Manufacturing Area because of the need to address PCB DNAPLs in the MHU.
2. Corrective measures also may be required for the SHU; further investigation is required to assess whether SHU groundwater has been impacted by RCRA hazardous constituents at this AOC.
3. Enhanced bioremediation (aerobic or anaerobic) is the recommended contingent technology if MNA is not successful within an acceptable timeframe or is unable to prevent continued contamination of the Mississippi River north of the GMCS.

Table 4-2 is a condensed list of pre-design and other tasks required to begin implementing the above-listed recommended technologies (the word "potential" is used to signify RCRA hazardous constituents that could be present but have not been confirmed through sampling).



**Table 4-2: Additional Required Pre-Design Activities for AOCs at the W.G. Krummrich Facility**

AOCs	Additional Tasks Required		
	Investigations	Pilot Tests	Other
Former PCBs Manufacturing Area	Delineate horizontal and vertical extent of dissolved-phase PCB homologs and PCB DNAPLs in the MHU	Conduct pilot test of ISTD technology in the vadose zone, SHU, and MHU	Prepare conceptual design of full-scale ISTD system following pilot test
Former Chlorobenzene Process Area	Delineate horizontal and vertical extent of MCB and DCBs DNAPLs in the SHU and MHU	Conduct pilot test of ISTD technology in the vadose zone and SHU	Prepare conceptual design of full-scale ISTD system following pilot test
Former Chlor-Alkali Production Area	<ul style="list-style-type: none"> <li>Determine if groundwater in the SHU has been impacted by mercury</li> <li>Delineate horizontal and vertical extent of VOCs impacts in the SHU</li> </ul>	None	<ul style="list-style-type: none"> <li>Determine waste classification of VOC-contaminated soil</li> <li>Determine waste classification of mercury-contaminated soil<sup>1</sup></li> <li>Locate off-site landfill(s) for disposal of VOCs- and mercury-contaminated soil</li> </ul>
Former Lot F Drum Disposal Area	None	None	<ul style="list-style-type: none"> <li>Install additional monitoring wells downgradient of the disposal area to monitor trends in groundwater quality</li> <li>Draft institutional control documents and file with local authorities<sup>2</sup></li> </ul>
Central Plant Process Area	Assess whether the SHU has been contaminated by VOCs and delineate horizontal and vertical extent of any such contamination	None <sup>3</sup>	<ul style="list-style-type: none"> <li>Prepare conceptual design of full-scale SVE system</li> <li>Determine waste classification of metals-contaminated soil<sup>4</sup></li> <li>Locate off-site landfill(s) for disposal of metals-contaminated soil</li> </ul>
Former Chlorobenzene and Benzene Storage Area	Delineate horizontal and vertical extent of benzene- and phenol-contaminated groundwater in the SHU	<ul style="list-style-type: none"> <li>Conduct pilot test of SVE technology<sup>3</sup></li> <li>Further assess geochemical properties in the SHU<sup>4</sup></li> </ul>	<ul style="list-style-type: none"> <li>Prepare conceptual design of full-scale SVE system</li> <li>Determine waste classification of metals-contaminated soil<sup>5</sup></li> <li>Locate off-site landfill(s) for disposal of metals-contaminated soil</li> </ul>

**Table 4-2: Additional Required Pre-Design Activities for AOCs at the W.G. Krummrich Facility**

AOCs	Additional Tasks Required		
	Investigations	Pilot Tests	Other
Former North Plant Process Area	None	None	<ul style="list-style-type: none"> <li>Prepare conceptual design of full-scale SVE system</li> <li>Locate off-site landfill(s) for disposal of BAP-contaminated soil</li> </ul>
Former PCB Warehouse Area	<ul style="list-style-type: none"> <li>Delineate horizontal and vertical extent of PCBs in vadose zone soil</li> <li>Assess whether groundwater in the SHU has been contaminated by VOCs, SVOCs, and/or PCBs</li> </ul>	None	Locate off-site TSCA-permitted landfill for disposal of PCBs-contaminated soil
DNT Contamination East of "G" Street	<ul style="list-style-type: none"> <li>Delineate horizontal and vertical extent of 2,4-DNT and 2,6-DNT in vadose zone soil</li> <li>Assess whether groundwater in the SHU has been contaminated by 2,4-DNT and 2,6-DNT</li> </ul>	Maybe; pending outcome of additional investigation activities	Pending outcome of additional investigation activities
Lot F Pipeline Corridor	Contamination is present within the MHU; will be addressed as part of the remedy for "Groundwater in the MHU and DHU" AOC (see below)		
Groundwater in the MHU and DHU	None	<ul style="list-style-type: none"> <li>Conduct monitoring program and trend evaluation to determine the feasibility of MNA</li> <li>Conduct pilot test of EABR technology (EABR would be the backup approach, if MNA fails)</li> </ul>	Continue quarterly groundwater monitoring using the Plume Stability Monitoring Well Network

## Notes:

- Determine if TCLP mercury is present in the soil above regulatory threshold for hazardous waste under 40 CFR 261, Subpart C.
- Institutional controls for the Former Lot F Drum Disposal Area would include prohibitions on disturbing the existing RCRA cap and on any usage of groundwater beneath the disposal cell and/or within the downgradient zone of impact.



3. One on-site SVE pilot test should be sufficient to evaluate the potential performance of this technology at the facility. The AOC selected for this test is the Former Chlorobenzene and Benzene Storage Area, because of the larger quantity of VOC-contaminated soil and higher concentrations of VOCs relative to the other AOCs.
4. The June 2006 geochemical sampling indicated anaerobic, possibly iron-reducing, conditions at the AOC in monitoring well PSMW-5.
5. Determine if TCLP lead and/or arsenic are present in the soil above the respective regulatory thresholds for hazardous waste under 40 CFR 261, Subpart C.

## 5.0 COST ESTIMATE

This section presents preliminary cost estimates for the recommended corrective measures at each of the 11 AOCs addressed by this Report. The costs for each AOC are summarized in Table 5-1, and cost estimate detail sheets for each AOC are contained in Appendix D.

The purpose of these estimates is to provide an initial basis for financial assurance required by EPA's RCRA Program for all corrective action sites (other than those where clean closure is approved). It is a budgetary estimate, not an engineering estimate; as such, it is based on general industry cost factors developed from applications of the selected technologies at existing sites, and not on detailed estimates of equipment, materials, labor, and other resources. An engineering estimate should be prepared as part of pre-design activities, and financial assurance requirements revised as necessary.

Estimated capital (e.g., construction), O&M, monitoring, and net present worth costs were calculated for the selected remedy at each AOC. O&M costs also include the costs of maintaining (e.g., checking, repairing, and/or updating) engineering and institutional controls, as applicable. These estimates represent preliminary values, which are likely to be changed as additional data and information becomes available. For several of the AOCs where the delineation of contamination has not been completed, the cost estimates are speculative and will probably need to be revised.

The following general assumptions apply to all cost estimates shown in Table 5-1 below:

- An annualized discount rate of five percent and an annual inflation rate of four percent were assumed.
- Soils contaminated by F- or U-listed solvents were assumed to be media impacted with hazardous waste. The low-end unit cost assumes no treatment is required to meet LDRs (i.e., all constituents present in soil are below ten times the applicable UTS') [EPA, 2006b], and the high-end cost assumes that some form of treatment (e.g., stabilization, bio-treatment, or thermal treatment) is required prior to land disposal. Soils contaminated only by metals or PAHs are assumed to be regulated as non-hazardous special wastes, because these constituents are likely not linked to former operations and hazardous waste streams known to have been generated at the facility.
- The MHU and DHU corrective measures are, at least in the short term, dependent on continued operation of the GMCS downgradient from Site R. This barrier prevents contaminants from the CERCLA SA2 OU, as well as from the facility, from migrating into the Mississippi River. However, because the RCRA Program can impose financial assurance requirements, there is a possibility that EPA would want to include the barrier O&M costs and ongoing sediment and surface water monitoring costs for the river in cleanup costs for the facility. Therefore, MHU/DHU



remediation costs and total facility costs are presented both with and without the GMCS O&M and monitoring costs (see Table 5-1).

- Unit cost information for the various technologies was obtained from the following sources:
  - ISTD: Baker [2005]
  - SVE: EPA [2001], FRTR [2006]
  - Excavation and off-site disposal: IEPA [2005] for local disposal costs for non-hazardous waste.

Additional specific assumptions used to estimate remediation and related costs are contained in Appendix D.



Table 5-1: Preliminary Cost Estimates for Corrective Action at RCRA AOCs at the W.G. Krummrich Facility

AOCs	Average/Most Probable Estimate <sup>1</sup>	Maximum/Most Conservative Estimate <sup>1</sup>	Selected Technology or Technologies	Comments
Former PCBs Manufacturing Area	\$17,491,000	\$34,084,000	ISTD	Average/Most Probable Estimate assumes remediation of the vadose zone and SHU. Maximum/Most Conservative Estimate assumes remediation of the vadose zone and SHU and also includes treatment of PCB DNAPLs in the MHU. The unit cost of ISTD at this AOC is considerably higher than for the Former Chlorobenzene Process Area due to the temperatures (350 °C to 400 °C) required to mobilize and extract or destroy PCB DNAPLs and to the more-stringent TSCA regulations that allow less ability to use risk-based CMOs compared to RCRA.
Former Chlorobenzene Process Area	\$4,404,000	\$5,845,000	ISTD	Both estimates assume remediation of the two concentrated areas of DNAPLs in the center and north of this AOC, respectively, in both the vadose zone and SHU (refer to Figures 3-2 through 3-5). Other portions of the AOC are assumed not to contain DNAPLs in quantities sufficient to pose a risk to groundwater in the MHU.
Former Chlor-Alkali Production Area	\$176,000	\$291,000	Excavation	Both estimates assume excavation of hot-spot areas in the vadose zone impacted by mercury, MCB, PCE, and/or benzene.
Former Lot F Drum Disposal Area	\$404,000	\$914,000	Existing RCRA Cap, MNA	Assumes addition of three to five new monitoring wells to complete a suitable long-term monitoring well network for this AOC. A cap maintenance/monitoring period of 15 years is assumed for the Average/Most Probable Estimate, and a cap maintenance/monitoring period of 40 years is assumed for the Maximum/Most Conservative Estimate.
Central Plant Process Area	\$985,000	\$2,393,000	SVE, Excavation	Assumes that the majority of the contaminated soil at this AOC will be addressed by SVE (i.e., VOCs present above site-specific CMOs). For preliminary cost estimating, it was assumed that two-thirds of the soil volume would require remediation by SVE, and the remaining one-third could be addressed through risk-based CMOs or engineering controls (this estimate must be revised once final CMOs are selected). Hot-spot excavation of BAP- and metals-contaminated soil is also assumed.



Table 5-1: Preliminary Cost Estimates for Corrective Action at RCRA AOCs at the W.G. Krummrich Facility

AOCs	Average/Most Probable Estimate <sup>1</sup>	Maximum/Most Conservative Estimate <sup>1</sup>	Selected Technology or Technologies	Comments
Former Chlorobenzene and Benzene Storage Area	\$884,000	\$2,266,000	SVE, Excavation	Assumes that the majority of the contaminated soil at this AOC will be addressed by SVE (i.e., VOCs present above site-specific CMOs). For preliminary cost estimating, it was assumed that two-thirds of the soil volume would require remediation by SVE, and the remaining one-third could be addressed through risk-based CMOs or engineering controls (this estimate must be revised once final CMOs are selected). Hot-spot excavation of PCBs- and SVOCs-contaminated soil is also assumed. The SHU at this AOC is impacted by high levels of benzene, but this cost estimate does not include groundwater remediation costs because, at this time, there is insufficient data to select a technology.
North Plant Process Area	\$214,000	\$506,000	SVE	Assumes that an SVE system would be installed to address vadose zone soil impacted by MBK and other VOCs.
Former PCB Warehouse Area	\$42,000	\$71,000	Excavation	Assumes excavation of PCBs-contaminated soils east of the former PCB Warehouse building and disposal at a TSCA-permitted landfill.
MHU and DHU				
• Without SA2 GMCS Costs	\$4,551,000	\$8,622,000	Existing GMCS, MNA	All four estimates for the MHU/DHU assume that between five and 15 additional monitoring wells will be required to complete the long-term monitoring network. Groundwater sampling is assumed to occur quarterly for the first two years, semi-annually from Year 3 through Year 10, and annually thereafter. For the Average/Most Probable Estimate, the monitoring period is assumed to be 40 years; for the Maximum/Most Conservative Estimate, the monitoring period is assumed to be 60 years. During the remediation period, it is assumed that a groundwater use restriction would be placed on the MHU and DHU, and initial costs for filing the land use control and annual checking and maintenance costs are included in all estimates.

Table 5-1: Preliminary Cost Estimates for Corrective Action at RCRA AOCs at the W.G. Krummrich Facility

AOCs	Average/Most Probable Estimate <sup>1</sup>	Maximum/Most Conservative Estimate <sup>1</sup>	Selected Technology or Technologies	Comments
• With SA2 GMCS Costs	\$59,953,000	\$84,717,000	Existing GMCS, MNA	The annual O&M costs for the GMCS were obtained from the 2004 CMS [Solutia, 2004a] for the facility. Operation of the GMCS is assumed to occur for 40 years in the Average/Most Probable Estimate and for 60 years in the Maximum/Most Conservative Estimate. Both estimates include costs for biennial sediment and surface water sampling in the Mississippi River, to confirm the effectiveness of the GMCS at preventing plume discharge into the river.
<b>Totals (without SA2 GMCS Costs)</b>	<b>\$29,151,000</b>	<b>\$54,992,000</b>		
<b>Totals (with SA2 GMCS Costs)</b>	<b>\$84,553,000</b>	<b>\$131,087,000</b>		

## Notes:

1. Costs are rounded to the nearest \$1,000. All costs are net present worth costs using an annual discount rate of five percent.



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## FIGURES

**APPENDIX A**

**PCB HOMOLOGS IN GROUNDWATER DATA, FORMER PCBs  
MANUFACTURING AREA**



**APPENDIX B**

**TECHNOLOGY EVALUATION FOR THE FORMER  
PCBs MANUFACTURING AREA**

## APPENDIX B

### TECHNOLOGY EVALUATION FOR THE FORMER PCBs MANUFACTURING AREA

#### B.1 Technology Screening

The following technologies were considered in the technology screening for the Former PCBs Manufacturing Area:

##### *B.1.1 Ex-Situ Technologies*

All of the following technologies would involve excavation of impacted soils from the Former PCBs Manufacturing Area and treatment/disposal in either an on-site system or at an off-site land disposal or incineration facility.

- Excavation and Off-Site Disposal. This alternative would involve excavating soil with concentrations exceeding the applicable CMOs for PCBs and other RCRA hazardous constituents. Soil would be staged on site or loaded directly into trucks for transport to off-site disposal facilities. Soil with concentrations of total PCBs less than 50 mg/kg could be disposed in either a RCRA hazardous waste or TSCA-permitted landfill. Soil with total PCBs concentrations between 50 mg/kg and 500 mg/kg would need to be disposed in a TSCA-permitted landfill. Soil with total PCBs concentrations above 500 mg/kg would likely have to be incinerated in a TSCA-permitted incinerator.
- Taciuk Process. The Taciuk Process was originally developed to extract crude oil from tar sands in Western Canada and has been used for at least one PCBs-contaminated site (Outboard Marine Corporation [OMC] Superfund Site, Waukegan, Illinois). The main component of the Taciuk system is a rotary kiln, which is used to desorb PCBs from excavated soil. A heater and air handler are located at the downstream end of the kiln, which heat the incoming air to approximately 1,200 °F and then blow it past the tumbling PCBs-impacted soils (i.e., a countercurrent flow). The PCBs-laden air stream captured from the kiln is then directed to a condenser, which liquefies the PCBs. The liquid PCBs are then conveyed into a storage tank and eventually transported to an off-site TSCA-permitted incinerator for destruction. Fugitive air emissions from the kiln are typically conveyed (in sequence) through a cyclone and baghouse to remove particulates and a carbon adsorption bed to remove PCBs and other organics, before being discharged to the atmosphere. A removal efficiency for total PCBs of 99.9999 percent is typically required by the EPA's TSCA Program for this type of system [EPA, no date 1].
- Aerobic Bioremediation. There are at least two available methods for ex-situ bioremediation of PCBs. The first, which was used at the U.S. Department of Energy's (DOE's) Savannah River Site, involves placing the excavated soils in long



windrows, similar to a composting operation [Lewis, et al, 2003]. The material in the windrows is periodically turned to promote aeration, and specialized microbes, nutrients, water (to maintain optimal moisture levels), and/or a carbon source (e.g., manure) are sometimes added to accelerate biodegradation. The second configuration, which was used at the French Limited Superfund Site in Crosby, Texas, involves mixing the PCBs-contaminated soil with a proprietary bio-slurry [EPA, no date 2]. The slurry mixture is then introduced into lined lagoons, where biodegradation occurs. In both configurations, piping systems are installed within the windrows or lagoons to supply oxygen, which promotes aeration and accelerates breakdown of PCBs and other organic contaminants. In the windrow system, oxygen gas is piped in, whereas in the slurry-phase system liquid oxygen is added.

- Soil Washing/Solvent Extraction. The soil washing or organics extraction process was demonstrated at the New Bedford Harbor, Massachusetts Superfund Site, in 1989. The technology utilizes a petroleum-based solvent to extract PCBs from soil, sediment, or other solid media (PCBs are non-polar and have low solubilities in water). The oil fraction containing the PCBs is decanted from the water and solids fractions and is then conveyed to a pressure reducer, which vaporizes the petroleum solvent (a mixture of propane and butane), leaving a separate, nearly pure PCBs phase. The liquid PCBs are transported off-site for incineration, and the solvent is re-liquified in a compressor and recycled to treat additional soils [EPA, 1990]. Another variation on the solvent extraction process is the Terra-Kleen/Sonoprocess™ combination of technologies. In this two-stage process, a proprietary solvent is first used to strip contaminants (PCBs, VOCs, SVOCs, dioxins, and some metals) from the soil adsorption sites. The “dirty” solvent is then subjected to a proprietary Sonoprocess™ unit, which dechlorinates the contaminant molecules through: (1) addition of sodium, and (2) simultaneous excitation of the concentrate using strong sound waves [Sonic Environmental Solutions, 2006].
- Ex-Situ S/S. S/S has been evaluated as a potential technology for treating PCBs in sediment at the New Bedford, Massachusetts Superfund Site. This technology, which is frequently used at metals-contaminated sites, relies on: (1) dewatering the contaminated media to the extent practicable; and (2) mixing the impacted material with a stabilizing agent such as lime, fly ash, or cement kiln dust (CKD). The aim is normally to produce a stabilized material that will not leach the contaminant(s) of concern under a long-term management scenario, which might consist of re-emplacing the material at the site or transporting it to an off-site landfill for disposal. The contaminants are either macro-encapsulated in the media or undergo chemical fixation reactions at the surfaces where the contaminant and media come into contact.

### *B.1.2 In-Situ Technologies*

All of the following technologies would involve treatment of PCBs in soil and/or groundwater in situ (i.e., no excavation of contaminated soils).



- Enhanced Aerobic Bioremediation. In-situ aerobic bioremediation has been explored as a potential technology for remediating low to moderate concentrations of PCBs in soil and groundwater. This technology was tested by General Electric (GE) in the Upper Hudson River, New York sediments in 1991 by introducing hydrogen peroxide as an oxygen source as well as nutrients. The objective was to determine whether breakdown of PCBs into less-harmful chlorobenzoic acids (CBAs) could be accomplished through aerobic biodegradation pathways [Mikszewski, 2004].
- Enhanced Anaerobic Bioremediation. In-situ anaerobic bioremediation is a technology that has been applied with considerable success to sites contaminated with chlorinated ethanes, chlorinated ethenes, and higher-order (more oxidized) chlorinated methanes. The primary (i.e., most rapid and complete) degradation process is usually reductive dechlorination, by which chlorine atoms on the base hydrocarbon molecule are sequentially replaced by hydrogen atoms, thus resulting in more reduced chlorinated molecules and eventually innocuous compounds (e.g., carbon dioxide, water, and chloride ions). For PCBs, this technology has been tested at the bench scale in laboratories and at the field pilot scale on: (1) sediments at the Woods Pond of the Housatonic River in Massachusetts; and (2) at a demonstration site in Mississippi by the USACE [Mikszewski, 2004]. An in-situ remedial configuration using this technology would likely involve injection of one or more of the following: (1) a carbon source to serve as a “food” source for the anaerobic microbes; (2) macro- and micro-nutrients to sustain microbial growth; and (3) specialized microbes that can both thrive in a PCBs-rich environment and can effectively use PCB molecules as electron acceptors.
- Chemical Reductive Dechlorination Using Nano-Scale ZVI. Nano-scale ZVI is one of the most interesting technology developments in the remediation industry today. Nano-scale ZVI particles would serve as electron donors and initiate a reductive dechlorination process similar to that described above for anaerobic bioremediation, leading to sequential breakdown of PCBs into innocuous compounds. The potential advantage of nano-scale ZVI over other technologies is the dramatically greater surface area of the nano-scale particles, which is expected to maximize contaminant-reagent contact to levels not previously possible (thus leading to faster and more complete contaminant degradation). Enhancements to the nano-scale ZVI that have been considered and are being tested at the bench scale include: (1) a palladium catalyst to increase stability and prolong half-life of the ZVI in situ; and (2) oil droplets that protect the ZVI from premature oxidation and also enable the mixture to partition with DNAPLs (most of which are also non-polar), thus removing a greater share of contaminant mass. The latter process was developed by the U.S. National Aeronautics and Space Administration (NASA) and field-tested at sites on the Kennedy Space Center property in Florida.
- ISTD. The ISTD technology was first developed in the mid-1990s by Shell Oil, which subsequently licensed it to TTI of Fitchburg, Massachusetts. The technology relies on several processes, including dissolution of PCB DNAPLs, vaporization and aboveground capture of PCBs, and in-situ chemical oxidation and pyrolysis to extract



or treat PCBs to the target remediation objectives. A grid of heater-vacuum and heater-only wells are installed in the contaminated area. The heater wells each contain an electrically-powered ceramic heating element, which is capable of heating the soil in the immediate proximity of the wells to approximately 1,000 °F (the boiling points of PCBs range from 730 °F to 780 °F). The high temperatures aid in overcoming the interfacial tension between the DNAPL and aqueous phases, increasing the solubility of the contaminants and decreasing their viscosity. Simultaneously, a vacuum is applied to pull PCBs toward the wells, where some are destroyed by in-situ oxidation or pyrolysis. The majority of the PCBs are extracted and treated in an APC train, normally consisting of a cyclone, wet scrubber, thermal oxidizer, baghouse, and/or activated carbon bed to achieve destruction of 99.9999 percent of PCBs prior to discharge [TTI, 2006a].

- In-Situ Chemical Oxidation (ISCO). ISCO is another technology that is growing in prominence, particularly for sites with high dissolved organic contaminant concentrations and/or DNAPLs. In this technology, a strong oxidant is introduced into the formation of concern. Through electron transfer reactions from the contaminants to the oxidant (many of which are not fully understood), the contaminant(s) are converted to innocuous end products—carbon dioxide, water, and (where chlorinated compounds are involved) chloride ions. Oxidants typically used include, in order of strength and reactivity: Fenton's Reagent (hydrogen peroxide and iron), ozone gas, persulfate, and permanganate. ISCO is most commonly utilized for groundwater treatment; however, the vadose zone can also be remediated by flooding it with sufficient water to maximize soil moisture content. Contaminants are driven into the aqueous phase through: (1) the preferential oxidation of the organic carbon fraction (i.e., removing adsorption sites where much of the contaminant has been fixated); and (2) creating a strong concentration gradient between the soil phase and dissolved phase.
- Surfactant or Co-solvent Flushing. This technology, which was first applied for tertiary recovery at crude oil production fields, operates by injecting either a biodegradable surfactant or a co-solvent (e.g., an alcohol) into the aquifer of concern. The surfactant or co-solvent facilitates removal of DNAPL constituents by: (1) reducing the interfacial tension between the DNAPL and water phases; (2) emulsifying DNAPL globules; and (3) increasing the maximum solubilities for the contaminants of concern. All of the above processes promote dissolution of the contaminants, which are subsequently extracted through pumping or vacuum wells to an aboveground treatment system. In the aboveground system, water, DNAPL, and surfactant/co-solvent are separated. The surfactant or co-solvent is recycled, the DNAPL is containerized for disposal at an off-site facility, and the water is treated and discharged (typically to a publicly-owned treatment works [POTW]).

The results of the technology screening are presented in Table B-1.



**Table B-1: Technology Screening for the Former PCBs Manufacturing Area**

Technology	Screening Result	Rationale
Excavation and Off-Site Disposal	Accepted for further evaluation for the vadose zone;  Rejected from further evaluation for the SHU	<ul style="list-style-type: none"> <li>Excavation is a proven technology, capable of removing all PCBs-impacted soils and DNAPLs in the vadose zone.</li> <li>PCB DNAPLs have been detected at depths up to 60 ft bgs in the Former PCBs Manufacturing Area. Excavation to those depths would be impracticable because of extensive dewatering requirements and the cost of managing large quantities of contaminated groundwater.</li> </ul>
Taciuk Process	Accepted for the vadose zone;  Rejected for the SHU	<ul style="list-style-type: none"> <li>At the OMC Superfund Site, this technology was able to reduce PCBs concentrations in sediment from an initial range of 2,400 mg/kg to 23,000 mg/kg of total PCBs to a final range of between 0.4 mg/kg and 8.9 mg/kg [EPA, no date 1].</li> <li>As mentioned above for excavation and off-site disposal, excavation to 60 ft bgs would be impracticable because of extensive dewatering requirements and the cost of managing large quantities of contaminated groundwater.</li> </ul>
Ex-Situ Aerobic Bioremediation	Rejected	<ul style="list-style-type: none"> <li>In both applications of this technology, a significant amount of empty site area is required to either construct windrows of contaminated soil or construct a lagoon into which the soil/water/nutrient slurry can be treated. In its current configuration, the site lacks sufficient area to utilize this technology. The only available space would be on Lot F, but most of this parcel has already been sold by Solutia for commercial redevelopment.</li> </ul>
Soil Washing/Solvent Extraction	Accepted for the vadose zone;  Rejected for the SHU	<ul style="list-style-type: none"> <li>Soil washing/solvent extraction has been implemented on a demonstration scale for at least three sites: (1) New Bedford, Massachusetts Harbor; (2) USACE Confined Disposal Facility (CDF), Saginaw, Michigan; and (3) Installation Restoration Site 4 at the Naval Air Station (NAS), Northern Island, San Diego, California. Reductions in total PCBs concentrations of between 90 percent and 98 percent were reported at the New Bedford Site, and the average reduction in total PCBs at the NAS Site 4 was over 98 percent (no percent reduction data was available for the Saginaw CDF) [FRTR, 2006].</li> <li>As mentioned above for excavation and off-site disposal, excavation to 60 ft bgs would be impracticable because of extensive dewatering requirements and the cost of managing large</li> </ul>



**Table B-1: Technology Screening for the Former PCBs Manufacturing Area**

Technology	Screening Result	Rationale
		quantities of contaminated groundwater.
Ex-Situ S/S	Rejected	<ul style="list-style-type: none"> <li>There are a very limited number of applications demonstrating full-scale performance of this technology on contaminated soil or wastes containing PCBs, and no known applications on soil/waste containing PCB DNAPLs.</li> <li>PCBs are not destroyed or chemically transformed; therefore, there is a degree of risk that PCBs could remobilize and continue to represent a long-term threat to groundwater.</li> <li>In an ex-situ S/S demonstration project at New Bedford Harbor, three proprietary additives were tested to attempt to stabilize PCBs in sediment. The stabilized sediments were then analyzed by TCLP to simulate leaching effects. TCLP PCBs concentrations in the stabilized material ranged from 25 µg/L to 49 µg/L, which are all above applicable Illinois Class I and Class II groundwater quality standards [EPA, 2000; IPCB, 2006].</li> </ul>
In-Situ Aerobic Bioremediation	Rejected	<ul style="list-style-type: none"> <li>There are no known successful commercial-scale applications of this technology. The 1991 pilot tests on Hudson River sediment were inconclusive at best, because transformation of PCB congeners to CBAs was incomplete, due to: (1) the PCBs' strong affinity for the soil phase; and (2) inability to successfully introduce and maintain the required specialized microbes (e.g., H850) [Mikszewski, 2004].</li> </ul>
In-Situ Anaerobic Bioremediation	Rejected	<ul style="list-style-type: none"> <li>Although bench-scale tests on this process have been encouraging (especially when ferrous sulfate is added to drive the system toward sulfanogenic conditions), it has yet to be successfully demonstrated at the field scale. A pilot-scale study conducted by the USACE in 2003 produced disappointing results due to the PCBs' strong affinity for soil adsorption sites and slow rates of dechlorination, even after a carbon source was applied [Mikszewski, 2004].</li> <li>There is no evidence that in-situ anaerobic bioremediation would be effective at treating PCB DNAPLs.</li> </ul>
In-Situ Chemical Reduction Using ZVI	Rejected	<ul style="list-style-type: none"> <li>There has been no demonstrated use of this technology in the field for remediation of PCBs-containing media. Several bench-scale tests performed at the University of New Hampshire</li> </ul>

**Table B-1: Technology Screening for the Former PCBs Manufacturing Area**

Technology	Screening Result	Rationale
		(UNH) reported very encouraging results (i.e., reductions of 56 percent to 84 percent of total PCBs in a single day). However, these data have not been independently confirmed, and UNH researchers were unable to formulate clear transformation pathways and mass balances explaining the ultimate fate of the PCBs [Mikszewski, 2004].
ISTD	Accepted	<ul style="list-style-type: none"> <li>ISTD has been successfully used on a commercial scale at five sites to reduce total PCBs concentration in soil by greater than 98 percent [TTI, 2006a].</li> <li>During a 72-hour bench-scale treatability test of this technology on soil cores from the Former PCBs Manufacturing Area, the mass of total PCBs was reduced by greater than 99.8 percent in all three test cores [TTI, 2006b].</li> </ul>
ISCO	Rejected	<ul style="list-style-type: none"> <li>As pointed out in Solutia [2005], the unconsolidated soils at the facility are derived from limestone bedrock and thus have a high organic carbon content (i.e. greater than 0.1 percent). At carbon fractions greater than 0.1 percent, it has been shown that the oxidant demand curve (i.e., pounds of oxidant required to oxidize each pound of contaminants) becomes very steep, thus increasing project costs and/or duration considerably [Clayton, 2004]. Thus, while there are many successful ISCO applications at the commercial scale, it is not an optimal technology to remediate PCBs at the facility.</li> </ul>
Surfactant or Co-solvent Flushing	Rejected	<ul style="list-style-type: none"> <li>There is one known demonstration project where surfactant or co-solvent flushing was used to treat PCBs-contaminated soil. In 1991, the General Motors (GM) North American Operations Research and Development Center introduced a surfactant solution to a 15 yd<sup>3</sup> test volume of soil containing a maximum total PCBs concentration of 6,000 mg/kg. After flushing eight pore volumes of surfactant solution through the test volume, only approximately 24 percent of the total contaminant mass was removed [Jafvert, 1996]. Because this technology is still in the emergent phase for PCBs, it is not recommended for use at the Former PCBs Manufacturing Area.</li> </ul>



## **B.2 Evaluation Against Threshold Criteria**

Each of the four accepted technologies should meet the four threshold criteria listed in EPA [1996]. All would increase protectiveness of human health and the environment by removing significant quantities of PCBs from the subsurface source areas. Each of the accepted technologies has also shown an ability, at one or more sites, to reduce total PCBs concentrations in soil to a general range of likely corrective action objectives (i.e., 1 mg/kg to 10 mg/kg, although engineered controls might be required for concentrations above 1 mg/kg). Data regarding attainment of groundwater corrective action objectives is less prevalent, because most PCBs releases equilibrate in shallow soils before migrating into groundwater. All of the accepted technologies have the capability to control the source and significantly reduce source mass, although ISTD is the only accepted technology that could practicably contain or remove PCB DNAPLs below the water table. The three accepted ex-situ technologies (off-site disposal, Taciuk process, and soil washing) would all be subject to RCRA and TSCA waste management requirements either for the contaminated soil (off-site disposal) or the concentrated PCBs extract (Taciuk process and soil washing).

## **B.3 Evaluation Against Balancing Criteria**

Table B-2 summarizes the evaluation of the four accepted technologies against the five balancing criteria in the ANPR:



**Table B-2: Technology Evaluation for the Former PCBs Manufacturing Area**

Technologies	Balancing Criteria				
	Long-Term Reliability and Effectiveness	Reduction of Toxicity, Mobility, and Volume of Waste	Short-Term Effectiveness	Implementability	Cost
Excavation and Off-Site Disposal	<ul style="list-style-type: none"> <li>• Vadose zone soil above remediation objectives would be permanently removed from the site, except in areas with existing structures or utility interferences.</li> <li>• Would not include any ongoing remediation systems or technologies; therefore, there are no long-term O&amp;M or monitoring requirements.</li> <li>• Would not be an effective remedy for the SHU, due to dewatering requirements and depth of detected PCB DNAPLs.</li> </ul>	<ul style="list-style-type: none"> <li>• Would remove most or all contaminated vadose zone soil from the site.</li> <li>• Highly-impacted soils (i.e., above 500 mg/kg of total PCBs) would be incinerated, thus greatly reducing toxicity and volume of PCBs-contaminated soil. However, soil with total PCBs between 50 mg/kg and 500 mg/kg would likely be disposed in a TSCA landfill (due to the high costs of incineration); thus, little or no reduction in toxicity, mobility, and volume would occur for those soils.</li> </ul>	<ul style="list-style-type: none"> <li>• Potential short-term impacts associated with this technology include: (1) fugitive emissions of soil particles with adsorbed PCBs; and (2) diesel emissions, traffic, and noise associated with trucks and excavation equipment.</li> <li>• Because the Former PCBs Manufacturing Area is not currently operational, impacts to facility operations would be minimal.</li> </ul>	<ul style="list-style-type: none"> <li>• Proven technology, implemented at thousands of sites in Illinois and across the nation.</li> <li>• The number of available commercial disposal facilities for PCBs-impacted soil (especially incinerators) is very limited due to the complexity and time associated with obtaining a TSCA permit and public opposition to such facilities. In past years, there have been occasions when no commercial PCBs incinerators were operational anywhere in the United States.</li> <li>• No special permits or approvals would be required to implement this technology at the facility.</li> </ul>	<ul style="list-style-type: none"> <li>• Excavation costs typically range between \$5 per yd<sup>3</sup> and \$15 per yd<sup>3</sup></li> <li>• Commercial landfill costs for PCBs-impacted soil normally range between \$200 per ton and \$800 per ton (including transportation) [EPA, 1997]</li> <li>• Commercial incineration costs for highly PCBs-impacted soils normally range between \$600 per ton and \$1,000 per ton (including transportation) [EPA, 1997]</li> </ul>



**Table B-2: Technology Evaluation for the Former PCBs Manufacturing Area**

Technologies	Balancing Criteria				
	Long-Term Reliability and Effectiveness	Reduction of Toxicity, Mobility, and Volume of Waste	Short-Term Effectiveness	Implementability	Cost
Taciuk Process	<ul style="list-style-type: none"> <li>In the demonstration project at the OMC Superfund Site, a five-ton-per-hour Taciuk system successfully reduced total PCBs concentrations in the in-feed soil from a range of 2,400 mg/kg to 23,000 mg/kg to a range of 0.4 mg/kg to 8.9 mg/kg in the treated soil (most confirmatory samples contained less than 2 mg/kg of total PCBs).</li> <li>The system was able to achieve key project-specific air emissions limits of 99.9999 percent destruction and removal efficiency (DRE) for PCBs and less than 30 nanograms per dry standard cubic meter (ng/dscm) of dioxins and furans. Early in the test, it was found that approximately 70 percent of the flue gases were bypassing the activated carbon bed in the APC train. This problem was rectified, and the system was able to achieve the stringent air emissions limits mentioned above for the remainder of the test [EPA, no date 1].</li> </ul>	<ul style="list-style-type: none"> <li>As noted under "Long-term Reliability and Effectiveness," the average total PCBs reduction in contaminated soils at the OMC Site was greater than 99.9 percent. The technology effectively concentrates PCBs in the extracted solvent, thus significantly reducing the volume of PCBs-containing waste material.</li> <li>The volume of contaminated soil was not significantly changed during the treatment process; however, the majority of the treated soil achieved the project remediation objectives and thus could be safely returned to the site as fill material [EPA, no date 1].</li> <li>PCBs-impacted soils beneath the water table in the SHU and in the MHU at the Krummrich facility could not be effectively treated by this technology; hence, a significant amount of contaminant mass (including PCB DNAPLs) would remain in the AOC.</li> </ul>	<ul style="list-style-type: none"> <li>The primary short-term impact of concern is air emissions of PCBs, hydrochloric acid (HCl), and/or dioxins and furans. The required APC train typically includes a cyclone, quench chamber, baghouse, scrubber, and activated carbon bed.</li> <li>Approximately 50,000 gallons of concentrated PCBs extract (mostly scrubber oils) were generated and required off-site incineration.</li> <li>The system produces wastewater, primarily condensate from the vapor recovery system (i.e., the system that condenses PCBs into liquid for off-site disposal). At the OMC Site, the wastewater was treated using a combination of sand and other filter media, UV oxidation, and activated carbon adsorption and was then discharged to the local POTW [EPA, no date 1].</li> </ul>	<ul style="list-style-type: none"> <li>Although setup requirements are not specifically stated in the product literature [EPA, 1992], the process may require several acres of site area for setup of the rotary kiln, APC train, pre- and post-treatment material handling equipment, and soil piles.</li> <li>Due to the amount of material being processed using thermal methods, a TSCA permit would probably have to be obtained from EPA. Some vendors obtain a nationwide permit from EPA's Office of Pollution Prevention and Toxic Substances (OPPTS), which allows brief site-specific or state-specific modifications, thus reducing mobilization time.</li> </ul>	<ul style="list-style-type: none"> <li>The operating cost of the OMC demonstration project was approximately \$190 per ton, <u>not</u> including: (1) off-site incineration of the concentrated PCBs extract; and (2) air monitoring, sampling, and analysis costs.</li> </ul>



Table B-2: Technology Evaluation for the Former PCBs Manufacturing Area

Technologies	Balancing Criteria				
	Long-Term Reliability and Effectiveness	Reduction of Toxicity, Mobility, and Volume of Waste	Short-Term Effectiveness	Implementability	Cost
ISTD	<ul style="list-style-type: none"> <li>The ISTD technology has been effective at removing PCBs from shallow soils at sites in New York, Missouri, California (two sites), and Saipan Territory. Decreases in total PCBs concentrations in soil have ranged from 98.0 percent to 99.9 percent. Soil remediation objectives of 2 mg/kg or less were achieved at four of the five sites (the objective for the fifth site of 10 mg/kg or less was also met). Volumes of PCBs-contaminated soil treated have ranged from 175 yd<sup>3</sup> to 1,540 yd<sup>3</sup>, and depths of application were up to 17 ft bgs [Baker, 2005].</li> <li>ISTD systems are often able to attain high levels of mass removal within relatively short time periods (e.g., three months or less from startup to attainment of site corrective action objectives).</li> <li>Unlike most other in-situ remedial technologies, ISTD is not very sensitive to permeability variations in the soil matrix. Thermal conduction coefficients in soils generally vary only by approximately <math>\pm 2</math>, thereby enabling the matrix to be heated in a relatively uniform manner. Air permeability and</li> </ul>	<ul style="list-style-type: none"> <li>As noted under "Long-term Reliability and Effectiveness," average total PCB concentration reductions in soil of up to 99.9 percent have been realized during full-scale remediation projects.</li> <li>ISTD is able to simultaneously remediate PCBs contamination above and below the water table. ISTD is able to deliver sufficient heat energy to the subsurface to exceed the boiling points of PCBs, which are in the range of 730 °F to 780 °F. Therefore, soil moisture and groundwater are evaporated, after which dessication cracking occurs and the removal of total PCBs is enhanced (most VOCs and SVOCs are also either oxidized in situ or volatilized and withdrawn to the surface at or below the temperatures necessary to boil PCBs).</li> <li>If the volume flow rate of groundwater into the treatment zone is large, pumping wells or subsurface barriers may be required to ensure that the ISTD system can attain the target</li> </ul>	<ul style="list-style-type: none"> <li>The most significant short-term impact of ISTD is air emissions of PCBs and related contaminants produced by the elevated temperatures (specifically HCl and dioxins and furans). At sites where it has been used, the ISTD technology has met stringent air emissions limits, e.g., 99.9999 percent destruction or capture of PCBs and less than 30 ng/dscf of dioxins and furans. A multiple-stage APC train (i.e., cyclone, baghouse, wet scrubber, thermal oxidizer, and activated carbon bed) is typically required to achieve these control limits.</li> <li>Scrubber wastewater and/or sludges and spent activated carbon are generated and require management as PCBs-containing wastes (i.e., incineration at a TSCA-permitted facility).</li> </ul>	<ul style="list-style-type: none"> <li>The ISTD technology and methodology was licensed by Shell Oil to TTI. Licensing fees may be passed on to the RCRA facility owner/operator as a project cost.</li> <li>The ISTD system is typically mobilized to a site using three trailers: one for the heating, vapor withdrawal, and electric equipment; one for the APC equipment; and one control room trailer. Typically, less than 2,000 square feet are required for the equipment. On-site setup and breakdown time must be factored into the project schedule.</li> <li>The system requires numerous extraction wells and subsurface heating elements installed on a tight grid. Therefore, time and cost for up-front well installation and abandonment at the project's conclusion are significant.</li> <li>The system uses strong electric currents and high</li> </ul>	<ul style="list-style-type: none"> <li>According to TTI, the unit cost for ISTD projects generally ranges from \$200 per yd<sup>3</sup> to \$500 per yd<sup>3</sup> (the unit cost declines as the volume of soil treated increases). For PCBs, the costs are higher than for VOC-impacted sites because of the additional energy (in the form of electricity) required to heat the soil matrix to temperatures above 730 °F [Baker, 2005].</li> </ul>



**Table B-2: Technology Evaluation for the Former PCBs Manufacturing Area**

Technologies	Balancing Criteria				
	Long-Term Reliability and Effectiveness	Reduction of Toxicity, Mobility, and Volume of Waste	Short-Term Effectiveness	Implementability	Cost
Soil Washing/Solvent Extraction	<ul style="list-style-type: none"> <li>At the New Bedford Superfund Site, initial concentrations of total PCBs in sediment between 350 mg/kg and 2,575 mg/kg were reportedly reduced to concentrations of 8 mg/kg to 10 mg/kg in the treated sediment.</li> <li>Control of certain operational parameters (solvent feed flow rate and solvent-to-soil ratio) was reportedly difficult to achieve. Other problems encountered included leakage of fine solids into the processing equipment, retention of solids in the liquid extract of concentrated PCBs, and formation of a foam within the treated sediments storage pile. According to the technology vendor, most or all of these problems were caused by recycling of sediments due to the pilot-scale system's throughput capacity being too low to process the entire solids flow on one pass.</li> <li>The New Bedford demonstration and other demonstrations provided some evidence that the technology may selectively extract PCB congeners with higher molecular weights, thus leaving lighter congeners in the soil fraction [EPA, 1990].</li> </ul>	<ul style="list-style-type: none"> <li>As noted under "Long-term Reliability and Effectiveness," the average total PCBs reduction in the contaminated sediment at the New Bedford site was greater than 99.3 percent. The technology effectively concentrates PCBs in the extracted solvent, thus significantly reducing the volume of PCBs-containing waste material.</li> <li>The volume of contaminated soil was not significantly changed during the treatment process; however, the majority of the treated soil achieved project remediation objectives and thus could be safely returned to the site as fill material [EPA, 1990a].</li> <li>PCBs-impacted soils beneath the water table in the SHU and MHU at the Krummrich facility could not be effectively treated by this technology; hence, a significant amount of contaminant mass (including PCB DNAPLs) would remain in the source area.</li> </ul>	<ul style="list-style-type: none"> <li>The system generates a substantial amount of process wastewater (approximately five gpm during the New Bedford demonstration). This water must be treated and discharged to a POTW. Excess moisture from dewatering the treated soils can usually be recycled and used to help reduce the viscosity of the contaminated soil/solvent mixture [EPA, 1990].</li> <li>Air emissions are less significant than from the Taciuk process. Fugitive emissions of PCBs-containing particulates are still a concern, and air monitoring should be conducted for site workers and at the downwind boundary of the treatment zone.</li> </ul>	<ul style="list-style-type: none"> <li>Solvent extraction systems such as the one used at New Bedford typically are modular and transportable. One vendor (CF Systems) reported that approximately 4,000 square feet of site area are required to set up and operate a 200-ton-per-day system (not including soil storage piles and ancillary equipment).</li> <li>Commercial-grade liquid propane and/or butane is required; a nominal flow rate of 12 pounds per minute of solvent was established for the New Bedford demonstration.</li> <li>Pre-processing of the in-feed soil is required; particles larger than 3/16 inch must be size-reduced or screened out to prevent blockages and/or solids carryover [EPA, 1990].</li> </ul>	<ul style="list-style-type: none"> <li>The unit costs reported for the New Bedford project were \$148 per ton for sediment containing total PCBs averaging 580 mg/kg (90 percent removal efficiency) and \$447 per ton for hot spot sediment containing total PCBs averaging 10,000 mg/kg (99 percent removal efficiency). These unit costs do <u>not</u> include off-site incineration of the concentrated PCBs-containing solvent extract [EPA, 1990].</li> </ul>

Table B-2: Technology Evaluation for the Former PCBs Manufacturing Area

Technologies	Balancing Criteria				
	Long-Term Reliability and Effectiveness	Reduction of Toxicity, Mobility, and Volume of Waste	Short-Term Effectiveness	Implementability	Cost
	hydraulic conductivity variations do affect the transport and withdrawal of contaminants that are not destroyed in situ, although desiccation cracking and resultant creation of new flow pathways aids in mitigating the effects of these heterogeneities [Stegemeier, 1998].	temperatures for destruction or removal of PCBs.		temperatures within the treatment zone; therefore, the project area must be isolated to ensure site safety. In addition, a thermal blanket material and vapor barrier are often installed to prevent short-circuiting of heat to, and airflow from, the ambient atmosphere [TTI, 2006a].	



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**APPENDIX C**

**TECHNOLOGY EVALUATION FOR THE FORMER  
CHLOROBENZENE PROCESS AREA**



## APPENDIX C

### TECHNOLOGY EVALUATION FOR THE FORMER CHLOROBENZENE PROCESS AREA

#### C.1 Technology Screening

The following technologies were considered in the technology screening for the Former Chlorobenzene Process Area.

##### C.1.1 *Ex-Situ Technologies*

All of the following technologies would involve excavation of impacted soils from the Former Chlorobenzene Process Area and treatment in either an on-site system or at an off-site land disposal or incineration facility:

- Excavation and Off-Site Disposal. This alternative would involve excavating soil with concentrations exceeding the applicable corrective action objectives for RCRA hazardous constituents. Soil would be staged on site or loaded directly into trucks for transport to off-site disposal facilities. Because of the impacts to soil caused by spills of off-specification products (e.g., MCB), the soil would probably be classified a hazardous waste with a "U" waste code. The RCRA requirements for this type of hazardous soil are outlined in the LDR rule [EPA, 1994, as amended] and would entail pre-treatment of soil to levels less than ten times the applicable UTS' listed in the rule, following by land disposal of the treated residual.
- LTDD. LTDD is a process that uses heat to desorb and volatilize organic compounds from a soil matrix. First, contaminated soil is excavated and placed in a staging pile. A conveyor system is then used to transfer the soil into the LTDD unit, which is typically a rotary kiln or other form of cylindrical chamber. The rotating motion of the chamber serves to break up agglomerated soil particles (thus exposing maximum surface area to heating), and provides sufficient turbulence to facilitate uniform treatment. Residence times in the kiln are typically several seconds to minutes in duration, and temperatures of between 200 °F and 600 °F are commonly used. An air stream is simultaneously blown through the chamber and captures the volatilized organics, which are then conveyed to an APC system. The APC system usually includes a thermal oxidizer and particulate removal devices (e.g., cyclone, baghouse). When processing chlorinated compounds, wet scrubbers (to neutralize HCl) and/or activated carbon beds (to capture organic pollutants) are often also required. The treated soil is periodically sampled to confirm treatment completion and can usually be used as clean fill material on site or elsewhere.
- Aerobic Bioremediation. The most common forms of this technology involve excavating contaminated soil and placing it into treatment piles or windrows. The material is periodically turned to promote aeration, and specialized microbes,



nutrients, water, and/or a carbon source are often added to optimize contaminant breakdown. Aeration pipes are often also installed beneath or through the windrows to maximize delivery of oxygen to the soil and maintain temperatures within the ideal range for biodegradation (i.e., to keep the pile from overheating and inhibiting microbial action). Remediation time frames are often on the order of months; occasionally, a year or more of operation may be required to achieve remediation objectives for all contaminants.

- Phytoremediation. Phytoremediation, which uses plants to remove or fixate contaminants, can be performed either ex situ or in situ. As an example, the ex-situ approach would involve excavating contaminated soil and placing it into a treatment cell. The vegetation planted within the treatment cell might include hardy grasses or cattails (shallow layer) or trees such as poplars or cottonwoods for deeper (thicker) piles. Grassy vegetation, which is often used for remediating heavy metals or fuel oil contaminants, must be periodically harvested and either land disposed or incinerated once its absorptive capacity is reached. Trees may be planted as permanent or semi-permanent site features. Research has indicated that the most prevalent fate-and-transport pathway for VOCs such as MCB or benzene is uptake through the plant root systems, collection by major roots or stems, and volatilization or evapo-transpiration through the leaves [Carman, 2001]. Other forms of contaminant removal include fixation in the plant tissues, biodegradation in the rhizosphere (root zone), and stabilization at the root-soil interface.

#### *C.1.2 In-Situ Technologies*

- MNA. MNA is a systematic approach that aims to: (1) take maximum advantage of natural processes occurring in the subsurface; and (2) investigate, monitor, and verify that the optimal conditions for natural attenuation continue to occur and that contaminant concentrations eventually decrease to below risk-based cleanup criteria. For organic contaminants, the most important MNA process is naturally-occurring biodegradation, either aerobic or anaerobic. Additional processes that contribute to MNA include volatilization, dispersion, diffusion, dilution, sorption, and stabilization.
- SVE. The SVE technology uses a negative pressure applied to the subsurface to extract contaminants located above the water table. A vacuum blower, usually operating between five and 15 inches of mercury (60 to 200 inches of water), is connected to a series of extraction wells and underground pipes. The vacuum accomplishes the following: (1) removes soil vapors within the pore spaces, thus disturbing the equilibrium contaminant partitioning and driving additional adsorbed contaminants into the pore spaces; and (2) lowers the ambient vacuum in the subsurface below the ambient vapor pressures of the contaminants, thus causing them to volatilize. Once the vapors are brought aboveground, they are processed through a knockout drum to remove water vapor and then treated (if necessary) using a catalytic oxidizer or activated carbon bed to meet local air emissions limits. SVE systems can be up-scaled to include multiple blowers and process trains operating in parallel in situations where the treatment area and/or the volume of contaminated soil are large.



- Enhanced Aerobic Bioremediation. Aerobic bioremediation can be used to treat in-situ soil and/or groundwater. Oxygen is supplied to the subsurface using either air, gaseous oxygen, hydrogen peroxide, or proprietary reagents, such as slow-release magnesium peroxide (the ORC™ product marketed by Regenesis, Inc.). The oxygen stimulates aerobic respiration by indigenous bacteria, with the contaminants acting as electron donors and the oxygen molecules acting as electron acceptors. Conventional two-inch diameter wells or direct-push borings can be used to inject oxygen in various forms into an aquifer. For vadose zone applications, either a low-pressure air injection system is used (bioventing), or in source areas, a peroxide-based slurry can be injected through direct-push borings. At most sites, it is not necessary to add specialized bacteria (bio-augmentation) in order to degrade RCRA-regulated VOCs and SVOCs; however, bio-augmentation may be performed in certain cases to fully degrade recalcitrant compounds and/or accelerate the cleanup schedule. Macro- and micro-nutrients are also sometimes added to ensure optimal conditions for the microorganisms to degrade organic contaminants.
- Enhanced Anaerobic Bioremediation. Anaerobic bioremediation processes could be used at the Former Chlorobenzene Process Area. Most probably, a carbon source would need to be injected into the vadose and/or saturated zones to: (1) provide the hydrogen atoms required for the dechlorination reactions; and (2) rapidly consume available oxygen, thus driving the treatment area to anaerobic conditions and activating the dechlorinating bacteria. Various carbon sources have been used at chlorinated hydrocarbon sites, including simple carbohydrates (e.g., vegetable oil, dilute molasses, whey), sodium acetate, methanol, lactate, and proprietary, slow-release hydrogen donors (e.g., the HRC™ polylactate reagent marketed by Regenesis, Inc.). Typically, these liquids are injected into the aquifer of concern using conventional two-inch or four-inch diameter wells, and can be delivered either from tanks inside a central remediation building or using mobile injection equipment such as modified direct-push rigs. For groundwater remediation, any of the above reagents can be used; remediation of the vadose zone may require either injecting an HRC™ slurry or flooding the soil to artificially create saturated conditions.
- Chemical Reductive Dechlorination Using Nano-Scale ZVI. This technology could be applied at the Former Chlorobenzene Process Area in a similar fashion to the Former PCBs Manufacturing Area (refer to Appendix B). Molecules of MCB, DCBs, PCE, and other contaminants in the vadose zone and in the SHU would act as electron acceptors and undergo dechlorination processes, primarily via abiotic oxidation of the ZVI coupled with reduction of the contaminant molecules, but also via anaerobic bioremediation (the zero-valent iron would be oxidized to ferrous iron [Fe II] and thus promote iron-reducing conditions in the aquifer). ZVI could be injected with or without the enhancements previously described (i.e., palladium catalyst, oil droplets).
- ISTD. ISTD could be utilized to address VOCs and SVOCs in the vadose zone and SHU using a similar arrangement to that described in Appendix B for the Former PCBs Manufacturing Area. Because MCB, DCBs, and PCE all have lower boiling points than PCBs (270 °F, 173 °F to 180 °F, and 250 °F, respectively), the required



amount of energy delivered would be considerably less; this would allow larger grid spacings between heater and heater-extraction wells and/or a faster cleanup time, all other elements being equal. In addition, two other benefits would be realized: (1) steam stripping would contribute much more toward overall contaminant removal; and (2) boiling has been shown to occur at the triple point of a contaminant-water mixture—for example, volatilization of MCB begins occurring at approximately 90.2 °C (194 °F), 76 degrees below the pure compound's boiling point. APC system requirements may be less intensive than for PCBs-containing vapors, although acid gas scrubbing and/or activated carbon might be required to eliminate HCl and potential dioxins [Baker, 2002].

- ISCO. ISCO is commonly used to remediate various VOCs and SVOCs in soil and groundwater. The available oxidants and delivery methods would be similar to those described in Appendix B for the Former PCBs Manufacturing Area. While ISCO normally demonstrates optimal contaminant removal in saturated or near-saturated soils, it can also be used in the vadose zone if sufficient moisture is present or is introduced.
- Surfactant or Co-solvent Flushing. Flushing technologies have been utilized at a number of DNAPL-impacted sites to address source zone materials. While there is little recorded experience treating chlorobenzenes, surfactant flushing was utilized at the Bachman Road Dry Cleaner site in Oscoda, Michigan and a former dry cleaning facility at Camp Lejeune Marine Base, North Carolina. Co-solvent (alcohol) flushing was utilized at the Sage's Dry Cleaner site in Jacksonville, Florida. At all three sites, the target contaminants were PCE and its breakdown products (i.e., TCE, DCEs, and vinyl chloride). Flushing with surfactants and co-solvents would be performed in similar manner to that described in Appendix B for the Former PCBs Manufacturing Area.
- MPE. MPE is an extension of the SVE concept—however, higher vacuums are applied to the subsurface, with the objective usually being total fluids recovery (soil gas, groundwater, and DNAPLs). A high vacuum (usually between 15 inches Hg and 29 inches Hg) is applied using a rotary lobe blower or liquid ring pump, through a drop tube ("straw") within one or more recovery wells. The high vacuum combined with the small cross-sectional area of the tube creates turbulent flow conditions, thus causing droplets of groundwater and DNAPL to become entrained in the vapor stream. Separation equipment (e.g., oil skimmers and knockout drums) are installed aboveground to separate the different phases. DNAPL is recycled or disposed and the water and air streams are treated using activated carbon or other methods.

The results of the technology screening are presented in Table C-1.



**Table C-1: Technology Screening for the Former Chlorobenzene Process Area**

Technology	Screening Result	Rationale
Excavation and Off-Site Disposal	Rejected from further evaluation	<ul style="list-style-type: none"> <li>The area and volume of potentially impacted soil in this area are considerably greater than at the Former PCBs Manufacturing Area; therefore, this option is not practicable due to the cost of site work, transportation, and off-site disposal of the contaminated soil as a hazardous waste.</li> <li>This technology would realistically only be implementable in the vadose zone due to dewatering requirements; the SHU would have to be remediated by another method.</li> </ul>
LTTD	Accepted for further evaluation	<ul style="list-style-type: none"> <li>LTTD is a proven technology and effectively remediates a wide range of VOCs and SVOCs.</li> <li>Treated soil could be utilized as backfill for site redevelopment.</li> <li>APC equipment ensures that local air quality standards can be met under almost all circumstances.</li> </ul>
Ex-Situ Aerobic Bioremediation	Rejected	<ul style="list-style-type: none"> <li>Insufficient site area to create the necessary treatment piles or windrows.</li> <li>Effectiveness of this technology for remediating chlorinated DNAPLs is unknown.</li> <li>Emissions of VOCs from the treatment piles would be a health and safety concern for on-site workers and occupants of surrounding properties.</li> </ul>
Phytoremediation	Rejected	<ul style="list-style-type: none"> <li>There is not adequate site area at the facility to construct the required vegetated treatment cells.</li> <li>Phytoremediation is a slow process and is hindered by the short growing season in this area of the United States.</li> <li>Ability of phytoremediation to remediate highly-impacted and DNAPL-containing soils is unknown.</li> </ul>
MNA	Rejected	<ul style="list-style-type: none"> <li>MNA rarely can be utilized for source area control or cleanup, due to: (1) elevated contaminant concentrations that inhibit natural processes, particularly biodegradation; and/or (2) the high concentrations make the remedial time period unacceptably lengthy.</li> </ul>
SVE	Accepted	<ul style="list-style-type: none"> <li>SVE would be capable of removing VOCs (e.g., MCB, PCE, benzene) from the vadose zone; DCBs generally have vapor pressures and Henry's Law constants approximately one order of magnitude</li> </ul>

**Table C-1: Technology Screening for the Former Chlorobenzene Process Area**

Technology	Screening Result	Rationale
		<p>below MCB, and therefore mass removal might be lower for these compounds.</p> <ul style="list-style-type: none"> <li>• SVE is a proven technology that has been utilized at hundreds of sites in Illinois and thousands of sites across the nation.</li> <li>• SVE is relatively inexpensive in comparison to most other remedial technologies.</li> </ul>
In-Situ Aerobic Bioremediation	Rejected	<ul style="list-style-type: none"> <li>• As discussed in Section 3.2.2., the bench-scale test conducted on soil from the SHU produced disappointing results; if significant source control is to be achieved, mass removals of 45 percent or lower would not suffice.</li> </ul>
In-Situ Anaerobic Bioremediation	Rejected	<ul style="list-style-type: none"> <li>• Data from other sites with chlorobenzene contamination have generally indicated that aerobic biodegradation pathways are more effective for contaminant mass removal, although some anaerobic biodegradation pathways have been documented.</li> <li>• Dissolved-phase PCE can often be effectively remediated using moderately to strongly anaerobic conditions; however, there is little information on how the coincident presence of chlorobenzenes might affect reductive dechlorination of PCE and its “daughter” VOCs. In addition, treatment of PCE DNAPLs using anaerobic bioremediation is a relatively new application (at the Idaho National Laboratory, TCE DNAPL was reportedly successfully removed using sodium lactate injections).</li> </ul>
Chemical Reductive Dechlorination Using Nano-Scale ZVI	Rejected	<ul style="list-style-type: none"> <li>• No demonstrated use of this technology specifically targeting chlorobenzenes on either the field scale or laboratory scale.</li> </ul>
ISTD	Accepted	<ul style="list-style-type: none"> <li>• As discussed in Section 3.2.3 of this Report, bench-scale tests of this technology on soil from the SHU produced excellent results (greater than 99 percent removal).</li> <li>• A generally successful field pilot-scale test of ISTD was conducted on soil impacted with chlorobenzenes at the Former Eastland Woolen Site, in Corinna, Maine [Baker, et al, 2002].</li> <li>• ISTD is capable of destroying or removing the full suite of VOCs and SVOCs detected in the Former Chlorobenzene Process Area.</li> </ul>



**Table C-1: Technology Screening for the Former Chlorobenzene Process Area**

Technology	Screening Result	Rationale
ISCO	Rejected	<ul style="list-style-type: none"><li>As pointed out in Solutia [2005], the unconsolidated soils at the site are derived from limestone bedrock and thus have a high organic carbon content (i.e. greater than 0.1 percent). At carbon fractions greater than 0.1 percent, it has been shown that the oxidant-demand curve (i.e., pounds of oxidant required to oxidize each pound of contaminants) becomes very steep, thus increasing project costs and/or duration considerably [Clayton, 2004]. Thus, while there are many successful ISCO applications at the commercial scale, it is not an optimal technology to remediate chlorobenzenes and other VOCs and SVOCs in the Former Chlorobenzene Process Area.</li></ul>
Surfactant and Co-Solvent Flushing	Accepted	<ul style="list-style-type: none"><li>Surfactant or co-solvent flushing has been used at several demonstration sites to remove PCE DNAPLs from shallow aquifers.</li><li>The other DNAPLs discovered in the Former Chlorobenzene Process Area (MCB and DCBs) have similar chemical properties to PCE (viscosities and solubilities); thus, they may also be effectively removed using this technology.</li></ul>
MPE	Rejected	<ul style="list-style-type: none"><li>As discussed in Section 3.2.1, an MPE system was installed as an interim measure in response to the 10,000-gallon MCB spill in January 2001. Due to the presence of many voids and fractures in the shallow subsurface materials, the system was unable to establish sufficiently high vacuums, and only ten gallons of MCB were recovered using the MPE system.</li></ul>

## C.2 Evaluation Against Threshold Criteria

With respect to the four threshold criteria listed in EPA [1996], each of the four technologies accepted for further evaluation should meet those requirements to some degree. By removing significant quantities of VOCs and/or SVOCs from contaminated soil at the Former Chlorobenzene Process Area, all four technologies would: (1) increase protection of human health and the environment, (2) facilitate progress toward meeting media cleanup standards, and (3) aid in controlling the source area. SVE is not designed to recover contaminants from below the water table. For LTTD, excavation below the water table is impracticable because of the large quantities of groundwater that must be managed; also, processing moist or wet soils would result in excessive energy requirements merely to evaporate the water. Of the two technologies capable of removing DNAPLs in the SHU (ISTD and surfactant/co-solvent flushing), only ISTD has



been utilized at a site with chlorobenzene contamination (Former Eastland Woolen Site). SVE and surfactant/co-solvent flushing are both in-situ methods but would produce some residual wastes (excess groundwater and/or DNAPL) requiring treatment or off-site disposal. Soil processed through an LTDD unit often can be reutilized on site as fill material, thus minimizing the amount of waste requiring secure off-site disposal.

### **C.3 Evaluation Against Balancing Criteria**

Table C-2 summarizes the evaluation of the four accepted technologies against the five balancing criteria in EPA [1996].

Table C-2: Technology Evaluation for the Former Chlorobenzene Process Area

Technologies	Balancing Criteria				
	Long-Term Reliability and Effectiveness	Reduction of Toxicity, Mobility, and Volume of Waste	Short-Term Effectiveness	Implementability	Cost
SVE	<ul style="list-style-type: none"> <li>SVE systems are very reliable because of their simplicity and long operating history at many different types of sites with VOC contamination. They can be constructed from off-the-shelf process equipment (e.g., blowers, activated carbon beds), measurement devices, and control systems.</li> <li>Implementation of SVE has resulted in attainment of corrective action objectives for VOCs at numerous sites. Contaminant levels typically decline rapidly during the first few months of operation, as the soil vapors in easily accessible advection pathways are removed. However, the problem of contaminant rebound is frequently encountered once the system is shut off. Contaminant rebound usually can be addressed by temporarily shutting down the system (or parts of it) to allow diffusion into advection pathways and then restarting the system to withdraw the now-accessible contaminants from the soil. Several on-off cycles may be required as the project approaches its cleanup goals.</li> </ul>	<ul style="list-style-type: none"> <li>SVE would remove substantial amounts of VOCs (e.g., MCB, PCE, and PCE daughter compounds) from the vadose zone, thus reducing toxicity, mobility, and volume. The masses of DCBs would also probably be reduced, although perhaps not to the same degree as the other, more volatile contaminants at the Former Chlorobenzene Process Area. The negative pressure gradient set up by an SVE system would also reduce mobility of the VOCs.</li> <li>SVE systems are not designed to remove contaminants below the water table. Small amounts may be recovered in groundwater sucked into the SVE system, although the technology's performance declines considerably if more than small, incidental amounts of water are captured.</li> </ul>	<ul style="list-style-type: none"> <li>SVE systems always produce air emissions. Illinois currently does not offer an exemption for remediation system (as many states do) for VOC emissions below a <i>de minimis</i> level. Therefore, an operating permit would need to be obtained. In addition, emissions of greater than 25 tons per year of total VOCs and/or ten tons per year of any individual Federal hazardous air pollutants (HAPs) would have to be controlled using APC equipment (e.g., catalytic oxidizer, activated carbon bed, flare).</li> <li>SVE systems generate some noise, although if the blower and other system components are properly balanced, the noise is usually not excessive.</li> <li>As mentioned previously, some groundwater is usually captured by the SVE system due to upwelling of the water table. Any contaminated groundwater recovered and separated by the knockout drum must be properly</li> </ul>	<ul style="list-style-type: none"> <li>SVE systems can be rapidly installed using conventional off-the-shelf parts and equipment; no special licenses are required. Extraction wells must be installed, as well as piping runs and headers to the treatment shed. Many vendors also offer modular, skid-mounted systems that can be utilized individually at small sites or at larger remediation sites by connecting several systems in parallel.</li> <li>The aboveground components of SVE systems are relatively compact. A small, dedicated remediation shed is often constructed, or the system can be installed within a corner or unused room of an existing building. The complexity of off-gas treatment required (i.e., APC equipment) usually dictates space requirements.</li> <li>After the initial startup and shakedown period, SVE systems do not require full-</li> </ul>	<ul style="list-style-type: none"> <li>There are many sources of information on SVE system costs. For example, one database indicates a unit cost of between \$10 per yd<sup>3</sup> and \$40 per yd<sup>3</sup> of contaminated soil [FRTR, 2006a]. Factors that influence construction and operating costs include: (1) sampling requirements; (2) depth of treatment; (3) local APC regulations and requirements; (4) operating pressure and airflow rate (governs blower sizing); and (5) special materials (e.g., stainless steel wells and piping might be required due to MCB's incompatibility with polyvinyl chloride [PVC]).</li> <li>According to EPA [2001], based on a survey of 18 projects, the unit cost of SVE decreased from between \$60 per yd<sup>3</sup> and \$350 per yd<sup>3</sup> for projects treating up to 10,000 yd<sup>3</sup> of soil, to less than \$5 per yd<sup>3</sup></li> </ul>



**Table C-2: Technology Evaluation for the Former Chlorobenzene Process Area**

Technologies	Balancing Criteria				
	Long-Term Reliability and Effectiveness	Reduction of Toxicity, Mobility, and Volume of Waste	Short-Term Effectiveness	Implementability	Cost
	<ul style="list-style-type: none"> <li>The system must be designed to minimize upwelling of groundwater, which, in addition to adding to waste management requirements, can cause or exacerbate VOC contamination in the vadose zone.</li> </ul>		managed, either through on-site treatment and/or discharge to a POTW sewer.	time labor; once the shakedown period is completed, weekly or monthly site visits to check system performance and collect readings typically suffice. In addition, frequent air and/or water sampling from the system is often conducted during the shakedown period to verify and optimize performance.	for projects treating relatively larger quantities of soil. In addition, based on a survey of 14 projects, unit costs decreased from between \$300 per pound and \$900 per pound of contaminants where up to 3,000 pounds of contaminants were removed, to less than \$15 per pound where larger quantities of contaminants were removed.



**Table C-2: Technology Evaluation for the Former Chlorobenzene Process Area**

Technologies	Balancing Criteria				
	Long-Term Reliability and Effectiveness	Reduction of Toxicity, Mobility, and Volume of Waste	Short-Term Effectiveness	Implementability	Cost
LTTD	<ul style="list-style-type: none"> <li>LTTD is generally very effective at treating soil contaminated with VOCs and SVOCs provided that the operating temperature is at or sufficiently above the contaminants' boiling points to ensure complete or near-complete removal. Steam stripping within the kiln or chamber can also provide substantial contaminant recovery.</li> <li>Because all contaminated soil is first excavated (dimensions of excavation are indicated by initial or confirmational sampling), this technology may remediate heterogeneous soils more effectively than an in-situ method. Regular sampling (e.g., collecting samples from the treated soil discharge belt or pile) and laboratory analysis is required to confirm that treatment is adequate.</li> <li>Unlike SVE, LTTD can treat a broader suite of contaminants (VOCs and SVOCs), provided that operating temperature are high enough.</li> </ul>	<ul style="list-style-type: none"> <li>LTTD is usually very effective at substantially reducing the toxicity, mobility, and volume of contaminants in soil. Contaminant mass removal of greater than 95 percent and/or attainment of stringent corrective action objectives are not uncommon.</li> <li>LTTD will not reduce contaminant toxicity, mobility, or volume in the SHU. Excavation and processing of soil below the water table would be impracticable.</li> </ul>	<ul style="list-style-type: none"> <li>Air emissions are a significant short-term impact associated with this technology. Even in cases where extensive APC equipment is utilized, negative public and stakeholder perception of emissions issues may jeopardize acceptance of this alternative.</li> <li>Soil piles must be properly staged on plastic sheeting or concrete pads to prevent additional soil contamination, covered when idle to reduce fugitive air emissions, and isolated from storm-water runoff to prevent contaminant migration and water quality impacts.</li> <li>Noise will occur due to kiln rotation, conveyor operation, and air blowers. In addition, vehicles used for handling soil (e.g., bucket loaders) produce noise and diesel emissions.</li> </ul>	<ul style="list-style-type: none"> <li>In the 1990s, several vendors owned mobile LTTD systems that could be broken down and transported from site to site. Due to the recent preference at most sites for in-situ remedies, there may be fewer companies offering this technology today versus ten to 15 years ago.</li> <li>Sufficient time and space must be allotted on site for system setup and breakdown. Usually, one acre or more of land area would be required for system components, material handling equipment, and soil piles.</li> <li>LTTD systems include mechanical equipment (conveyors, blowers, bearings and drive chains on kiln drums) that must be properly maintained and serviced during system operation. On-line availability is usually between 85 percent and 100 percent.</li> </ul>	<ul style="list-style-type: none"> <li>LTTD costs can range between \$40 per ton and \$300 per ton. In addition, soil excavation costs usually range between \$5 per ton and \$10 per ton. If the soil cannot be used as backfill on the site, the cost of clean fill (which varies based on locality) must also be factored into the project costs [FRTR, 2006b].</li> <li>According to EPA [2001], based on a survey of 17 projects where VOCs and SVOCs were treated using thermal desorption technologies, unit costs for projects where 20,000 tons of soil were treated were between \$100 per ton and \$300 per ton; costs decreased to less than \$50 per ton for projects treating larger quantities of soil (up to 105,000 tons).</li> </ul>



**Table C-2: Technology Evaluation for the Former Chlorobenzene Process Area**

Technologies	Balancing Criteria				
	Long-Term Reliability and Effectiveness	Reduction of Toxicity, Mobility, and Volume of Waste	Short-Term Effectiveness	Implementability	Cost
ISTD	<ul style="list-style-type: none"> <li>As mentioned previously, a pilot-scale test of the ISTD technology was performed at the Eastland Woolen Site. Two 55-gallon drums in series were filled with chlorobenzenes-contaminated soil and heated using band heaters wrapped around the drums. In addition, a blower and piping were attached to the drums in order to pull air through the soil, thus simulating the in-situ vacuum extraction process. By mass balance, between 60 percent and 75 percent of MCB, DCBs, and TCBs were either destroyed within the drums via chemical oxidation or were removed and captured in an activated carbon drum. TTI concluded that the mass removal was limited by temperature, because the soil could not be heated above approximately 230 °C (446 °F) by the band heaters. TTI also speculated that in-situ temperatures of between 400 °C (752 °F) and 500 °C (932 °F), which are achievable using ISTD, would have accomplished near-total removal (95 to 99 percent) of chlorobenzenes from the soil.</li> </ul>	<ul style="list-style-type: none"> <li>Using the correct design temperature and a sufficiently tight grid spacing, ISTD should achieve high toxicity, mobility, and volume reductions for all VOCs and SVOCs at the Former Chlorobenzene Process Area, in both the vadose zone and SHU. Design temperatures must take into account the energy required to boil off groundwater in the SHU soils; however, the Eastland Woolen pilot test indicated that steam stripping (which begins to occur at the eutectic temperature – approximately 180 °F for MCB) is the primary mass removal mechanism for chlorobenzenes.</li> </ul>	<ul style="list-style-type: none"> <li>The ISTD technology would produce air emissions of HCl and possibly dioxins and furans. As mentioned previously, extensive APC equipment is normally provided with the ISTD system (i.e., cyclone, baghouse, wet scrubber, thermal oxidizer, and/or activated carbon bed). Air stack sampling to verify compliance with Federal and Illinois air quality regulations would be required.</li> <li>Scrubber wastewater, sludges, and spent activated carbon would have to be properly managed as RCRA hazardous wastes.</li> </ul>	<ul style="list-style-type: none"> <li>The implementation requirements for ISTD at the Former Chlorobenzene Process Area would be similar to those discussed in Appendix B for the Former PCBs Manufacturing Area. Installation of heater and heater/vacuum wells might be more challenging in the western portion of this area, depending on how many of the original tanks and piping runs are present (the former rail car loading area is relatively free of aboveground equipment). Process sewers that are no longer in use might have to be excavated or blinded to enable installation of the required wells and prevent unintended migration of contaminants.</li> </ul>	<ul style="list-style-type: none"> <li>The costs to implement ISTD at the Former Chlorobenzene Process Area would likely be within the same order of magnitude as for the Former PCBs Manufacturing Area (i.e., between \$200 per yd<sup>3</sup> and \$500 per yd<sup>3</sup>). Information provided by TTI indicates that costs decrease somewhat for large-volume projects, and thus some economies of scale are expected for the Former Chlorobenzene Process Area [Baker, 2005].</li> </ul>



**Table C-2: Technology Evaluation for the Former Chlorobenzene Process Area**

Technologies	Balancing Criteria				
	Long-Term Reliability and Effectiveness	Reduction of Toxicity, Mobility, and Volume of Waste	Short-Term Effectiveness	Implementability	Cost
Surfactant/Co-Solvent Flushing	<ul style="list-style-type: none"> <li>Surfactant/co-solvent flushing has been shown to be reliable and effective in sand and silty sand terrain (similar to the vadose zone and SHU in the Former Chlorobenzene Process Area). The greatest potential design challenges would be: (1) the ability to deliver the surfactant or co-solvent to the areas requiring flushing, and (2) simultaneously preventing migration of DNAPL or dissolved-phase contamination outside of the treatment area. Generally, as the soil stratigraphy becomes more heterogeneous, the effectiveness of surfactant/co-solvent flushing decreases.</li> </ul>	<ul style="list-style-type: none"> <li>Surfactant/co-solvent flushing is typically employed primarily to remove DNAPL, and is not cost effective for addressing dissolved-phase contaminants in groundwater or adsorbed contaminants in the vadose zone. The typical remediation approach involves using surfactant flushing to remove the DNAPL source, in conjunction with technologies such as bioremediation to treat contaminant mass that has partitioned into the soil and/or water phases. Therefore, while reduction/capture of the DNAPLs is generally high, the overall reduction in toxicity, mobility, and volume of waste may be less than other technologies, unless a treatment train concept is employed.</li> </ul>	<ul style="list-style-type: none"> <li>The surfactant solution or co-solvents (e.g., alcohols) mix with contaminated groundwater and must be separated aboveground after being extracted through recovery wells. Where possible, the surfactant solution or co-solvent is recycled back into the subsurface, but contaminated groundwater must normally be treated and discharged to a POTW (at the end of the remediation period, all surfactant would have to be disposed, probably as a hazardous waste).</li> <li>Depending on where the aboveground process train is set up, some disruption of on-site activities may occur. At the facility, this impact would be reduced because the Former Chlorobenzene Process Area is inactive.</li> <li>Treatment occurs in situ; therefore, there are no residual wastes that require off-site disposal, other than contaminated groundwater and surfactant or co-solvent that can</li> </ul>	<ul style="list-style-type: none"> <li>In most states, including Illinois, injection of remediation reagents such as surfactants or co-solvents requires an underground injection control (UIC) permit or permit variance.</li> <li>The area required to construct the aboveground portion of the system will be somewhat greater than, for example, an SVE system, due to the complex surfactant mixing, separation, and groundwater treatment equipment.</li> <li>Surfactant flushing is a complex process and usually involves performing sequential flushes of surfactant and potable water equal to many times the pore volume of the contaminated area. More high-level technical expertise is required to properly plan and execute the remediation program than for most technologies, and the number of professionals with such experience is limited.</li> </ul>	<ul style="list-style-type: none"> <li>ITRC [2003] provides a range of costs for surfactant/co-solvent flushing of between \$65 per yd<sup>3</sup> and \$200 per yd<sup>3</sup> of DNAPL-impacted soil. In addition, from case histories of full-scale applications presented in the same document, total project costs ranged between \$840,000 and \$3 million.</li> </ul>



**Table C-2: Technology Evaluation for the Former Chlorobenzene Process Area**

Technologies	Balancing Criteria				
	Long-Term Reliability and Effectiveness	Reduction of Toxicity, Mobility, and Volume of Waste	Short-Term Effectiveness	Implementability	Cost
			no longer be recycled (i.e., has become too contaminated for re-injection).	Thus, the engineering costs associated with this technology may be high.	

## C.4 References

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**APPENDIX D**

**CORRECTIVE MEASURES COST ESTIMATE DETAIL SHEETS**



Solutia, Technology Selection Report (TSR) Cost Estimate  
Cost Summary Table (all AOCs)

All estimates are life-cycle, net present worth values. Assumed discount rates and inflation rates are five percent and four percent annual rates, respectively.

AOC	Average/Most Probable Estimate	Maximum/Most Conservative Estimate	Selected Technology or Technologies	Notes
Former PCB Warehouse Area	(\$42,000)	(\$71,000)	Excavation	Assumes excavation of PCB-contaminated soils east of the former PCB warehouse building.
MHU and DHU				
(a) Without Area 2 GCMS Costs	(\$4,551,000)	(\$8,622,000)	GMCS, MNA	All estimates assume that between five and 15 additional monitoring wells would be required to complete the long-term monitoring network. Groundwater sampling is assumed to occur quarterly for the first two years, semi-annually from Year 3 through Year 10, and annually thereafter. For the Average/Most Probable Estimate, the monitoring period is assumed to be 40 years; for the Maximum/Most Conservative estimate, the monitoring period is assumed to be 60 years. During the remediation period, it is assumed there would be a groundwater use restriction placed on the MHU and DHU, and initial costs for filing the land use control and annual checking and maintenance costs are included in both estimates.
(b) With Area 2 GCMS Costs	(\$59,953,000)	(\$84,717,000)	GMCS, MNA	The annual O&M costs for the GMCS were obtained from the 2004 CMS for the Krummrich Facility. Operation of the GMCS is assumed to occur for 40 years in the Average/Most Probable Estimate and for 60 years in the Maximum/Most Conservative Estimate. Both estimates include costs for biennial sediment and surface water sampling in the Mississippi River to confirm effectiveness of the GMCS at preventing plume discharge into the River.
Totals (without Area 2 GCMS Costs)	(\$29,151,000)	(\$54,992,000)		
Totals (with Area 2 GCMS Costs)	(\$84,553,000)	(\$131,087,000)		

Solutia, Technology Selection Report (TSR) Cost Estimate  
Cost Summary Table (all AOCs)

All estimates are life-cycle, net present worth values. Assumed discount rates and inflation rates are five percent and four percent annual rates, respectively.

AOC	Average/Most Probable Estimate	Maximum/Most Conservative Estimate	Selected Technology or Technologies	Notes
Former PCB Manufacturing Area	(\$17,491,000)	(\$34,084,000)	ISTD	Average/Most Probable Estimate assumes remediation of the vadose zone and SHU. Maximum/Most Conservative Estimate assumes remediation of the vadose zone and SHU and also includes treatment of PCB DNAPLs in the MHU. The unit cost of ISTD at this AOC is considerably higher than that for the Former Chlorobenzene Process Area due to the temperatures (350 to 400 degrees Celsius) required to mobilize and extract or destroy PCB DNAPLs.
Former Chlorobenzene Process Area	(\$4,404,000)	(\$5,845,000)	ISTD	Both estimates assume remediation of the two concentrated areas of DNAPL in the center and north of this AOC, respectively, in both the vadose zone and SHU. Other portions of the AOC are assumed not to contain DNAPLs in quantities sufficient to pose a risk to groundwater.
Former Chlor-Alkali Production Area	(\$176,000)	(\$291,000)	Excavation	Both estimates assume excavation of hot-spot areas in the vadose zone impacted by mercury, MCB, PCE, and/or benzene.
Former Lot F Drum Disposal Area	(\$404,000)	(\$914,000)	Existing Cap, MNA	Assumes addition of three to five new monitoring wells to complete a suitable long-term monitoring network for this AOC. A maintenance and monitoring period of 15 years is assumed for the Average/Most Probable Estimate, and a monitoring period of 40 years is assumed for the Maximum/Most Conservative Estimate.
Central Plant Process Area	(\$985,000)	(\$2,393,000)	SVE, Excavation	Assumes the majority of the contaminated soil at this AOC will be addressed by SVE (i.e., VOCs above site cleanup criteria). Hot-spot excavation of benzo(a)pyrene- and metals-contaminated soil is also assumed.
Former Chlorobenzene and Benzene Storage Area	(\$884,000)	(\$2,266,000)	SVE, Excavation	Assumes the majority of the contaminated soil at this AOC will be addressed by SVE (i.e., VOCs above site cleanup criteria). Hot-spot excavation of PCBs- and SVOCs-contaminated soil is also assumed. The SHU at this AOC is impacted by high levels of benzene; this cost estimate does not include groundwater remediation because at this time there is insufficient data to select a remedy.
North Plant Process Area	(\$214,000)	(\$506,000)	SVE	An SVE system would be installed to address vadose zone soil impacted by 2-hexanone and other VOCs.



Solutia, TSR Cost Estimate

AOC:

Former Lot F Drum Disposal Area

Maximum or Most Conservative Estimate

Discount Rate = 5.0%  
Inflation Rate = 4.0%

Quarterly Cap Inspections	Single Pay	34	(\$10,000)	(\$37,943)	0.19035	(\$7,223)
Cap Repair Budget	Single Pay	34	(\$3,000)	(\$11,383)	0.19035	(\$2,167)
Institutional Controls, Check and Maintain	Single Pay	34	(\$1,000)	(\$3,794)	0.19035	(\$722)
LTM, Years 2 and after (Annual)	Single Pay	34	(\$12,000)	(\$45,532)	0.19035	(\$8,667)
Quarterly Cap Inspections	Single Pay	35	(\$10,000)	(\$39,461)	0.18129	(\$7,154)
Cap Repair Budget	Single Pay	35	(\$3,000)	(\$11,838)	0.18129	(\$2,146)
Institutional Controls, Check and Maintain	Single Pay	35	(\$1,000)	(\$3,946)	0.18129	(\$715)
LTM, Years 2 and after (Annual)	Single Pay	35	(\$12,000)	(\$47,353)	0.18129	(\$8,585)
Quarterly Cap Inspections	Single Pay	36	(\$10,000)	(\$41,039)	0.17266	(\$7,086)
Cap Repair Budget	Single Pay	36	(\$3,000)	(\$12,312)	0.17266	(\$2,126)
Institutional Controls, Check and Maintain	Single Pay	36	(\$1,000)	(\$4,104)	0.17266	(\$709)
LTM, Years 2 and after (Annual)	Single Pay	36	(\$12,000)	(\$49,247)	0.17266	(\$8,503)
Quarterly Cap Inspections	Single Pay	37	(\$10,000)	(\$42,681)	0.16444	(\$7,018)
Cap Repair Budget	Single Pay	37	(\$3,000)	(\$12,804)	0.16444	(\$2,105)
Institutional Controls, Check and Maintain	Single Pay	37	(\$1,000)	(\$4,268)	0.16444	(\$702)
LTM, Years 2 and after (Annual)	Single Pay	37	(\$12,000)	(\$51,217)	0.16444	(\$8,422)
Quarterly Cap Inspections	Single Pay	38	(\$10,000)	(\$44,388)	0.15661	(\$6,951)
Cap Repair Budget	Single Pay	38	(\$3,000)	(\$13,316)	0.15661	(\$2,085)
Institutional Controls, Check and Maintain	Single Pay	38	(\$1,000)	(\$4,439)	0.15661	(\$695)
LTM, Years 2 and after (Annual)	Single Pay	38	(\$12,000)	(\$53,266)	0.15661	(\$8,342)
Quarterly Cap Inspections	Single Pay	39	(\$10,000)	(\$46,164)	0.14915	(\$6,885)
Cap Repair Budget	Single Pay	39	(\$3,000)	(\$13,849)	0.14915	(\$2,066)
Institutional Controls, Check and Maintain	Single Pay	39	(\$1,000)	(\$4,616)	0.14915	(\$689)
LTM, Years 2 and after (Annual)	Single Pay	39	(\$12,000)	(\$55,396)	0.14915	(\$8,262)
Quarterly Cap Inspections	Single Pay	40	(\$10,000)	(\$48,010)	0.14205	(\$6,820)
Cap Repair Budget	Single Pay	40	(\$3,000)	(\$14,403)	0.14205	(\$2,046)
Institutional Controls, Check and Maintain	Single Pay	40	(\$1,000)	(\$4,801)	0.14205	(\$682)
LTM, Years 2 and after (Annual)	Single Pay	40	(\$12,000)	(\$57,612)	0.14205	(\$8,184)
Periodic Expenditure Subtotal						(\$883,627)
TOTAL PRESENT WORTH COST						(\$913,484)



Solutia, TSR Cost Estimate

AOC:

Former Lot F Drum Disposal Area

Maximum or Most Conservative Estimate

Discount Rate = 5.0%  
Inflation Rate = 4.0%

Quarterly Cap Inspections	Single Pay	22	(\$10,000)	(\$23,699)	0.34185	(\$8,102)
Cap Repair Budget	Single Pay	22	(\$3,000)	(\$7,110)	0.34185	(\$2,430)
Institutional Controls, Check and Maintain	Single Pay	22	(\$1,000)	(\$2,370)	0.34185	(\$810)
LTM, Years 2 and after (Annual)	Single Pay	22	(\$12,000)	(\$28,439)	0.34185	(\$9,722)
Quarterly Cap Inspections	Single Pay	23	(\$10,000)	(\$24,647)	0.32557	(\$8,024)
Cap Repair Budget	Single Pay	23	(\$3,000)	(\$7,394)	0.32557	(\$2,407)
Institutional Controls, Check and Maintain	Single Pay	23	(\$1,000)	(\$2,465)	0.32557	(\$802)
LTM, Years 2 and after (Annual)	Single Pay	23	(\$12,000)	(\$29,577)	0.32557	(\$9,629)
Quarterly Cap Inspections	Single Pay	24	(\$10,000)	(\$25,633)	0.31007	(\$7,948)
Cap Repair Budget	Single Pay	24	(\$3,000)	(\$7,690)	0.31007	(\$2,384)
Institutional Controls, Check and Maintain	Single Pay	24	(\$1,000)	(\$2,563)	0.31007	(\$795)
LTM, Years 2 and after (Annual)	Single Pay	24	(\$12,000)	(\$30,760)	0.31007	(\$9,538)
Quarterly Cap Inspections	Single Pay	25	(\$10,000)	(\$26,658)	0.29530	(\$7,872)
Cap Repair Budget	Single Pay	25	(\$3,000)	(\$7,998)	0.29530	(\$2,362)
Institutional Controls, Check and Maintain	Single Pay	25	(\$1,000)	(\$2,666)	0.29530	(\$787)
LTM, Years 2 and after (Annual)	Single Pay	25	(\$12,000)	(\$31,990)	0.29530	(\$9,447)
Quarterly Cap Inspections	Single Pay	26	(\$10,000)	(\$27,725)	0.28124	(\$7,797)
Cap Repair Budget	Single Pay	26	(\$3,000)	(\$8,317)	0.28124	(\$2,339)
Institutional Controls, Check and Maintain	Single Pay	26	(\$1,000)	(\$2,772)	0.28124	(\$780)
LTM, Years 2 and after (Annual)	Single Pay	26	(\$12,000)	(\$33,270)	0.28124	(\$9,357)
Quarterly Cap Inspections	Single Pay	27	(\$10,000)	(\$28,834)	0.26785	(\$7,723)
Cap Repair Budget	Single Pay	27	(\$3,000)	(\$8,650)	0.26785	(\$2,317)
Institutional Controls, Check and Maintain	Single Pay	27	(\$1,000)	(\$2,883)	0.26785	(\$772)
LTM, Years 2 and after (Annual)	Single Pay	27	(\$12,000)	(\$34,800)	0.26785	(\$9,268)
Quarterly Cap Inspections	Single Pay	28	(\$10,000)	(\$29,987)	0.25509	(\$7,650)
Cap Repair Budget	Single Pay	28	(\$3,000)	(\$8,996)	0.25509	(\$2,295)
Institutional Controls, Check and Maintain	Single Pay	28	(\$1,000)	(\$2,999)	0.25509	(\$765)
LTM, Years 2 and after (Annual)	Single Pay	28	(\$12,000)	(\$35,984)	0.25509	(\$9,179)
Quarterly Cap Inspections	Single Pay	29	(\$10,000)	(\$31,187)	0.24295	(\$7,577)
Cap Repair Budget	Single Pay	29	(\$3,000)	(\$9,356)	0.24295	(\$2,273)
Institutional Controls, Check and Maintain	Single Pay	29	(\$1,000)	(\$3,119)	0.24295	(\$758)
LTM, Years 2 and after (Annual)	Single Pay	29	(\$12,000)	(\$37,424)	0.24295	(\$9,092)
Quarterly Cap Inspections	Single Pay	30	(\$10,000)	(\$32,434)	0.23138	(\$7,504)
Cap Repair Budget	Single Pay	30	(\$3,000)	(\$9,730)	0.23138	(\$2,251)
Institutional Controls, Check and Maintain	Single Pay	30	(\$1,000)	(\$3,243)	0.23138	(\$750)
LTM, Years 2 and after (Annual)	Single Pay	30	(\$12,000)	(\$38,921)	0.23138	(\$9,005)
Quarterly Cap Inspections	Single Pay	31	(\$10,000)	(\$33,731)	0.22036	(\$7,433)
Cap Repair Budget	Single Pay	31	(\$3,000)	(\$10,119)	0.22036	(\$2,230)
Institutional Controls, Check and Maintain	Single Pay	31	(\$1,000)	(\$3,373)	0.22036	(\$743)
LTM, Years 2 and after (Annual)	Single Pay	31	(\$12,000)	(\$40,478)	0.22036	(\$8,920)
Quarterly Cap Inspections	Single Pay	32	(\$10,000)	(\$35,081)	0.20987	(\$7,362)
Cap Repair Budget	Single Pay	32	(\$3,000)	(\$10,524)	0.20987	(\$2,209)
Institutional Controls, Check and Maintain	Single Pay	32	(\$1,000)	(\$3,508)	0.20987	(\$736)
LTM, Years 2 and after (Annual)	Single Pay	32	(\$12,000)	(\$42,097)	0.20987	(\$8,835)
Quarterly Cap Inspections	Single Pay	33	(\$10,000)	(\$36,484)	0.19987	(\$7,292)
Cap Repair Budget	Single Pay	33	(\$3,000)	(\$10,945)	0.19987	(\$2,188)
Institutional Controls, Check and Maintain	Single Pay	33	(\$1,000)	(\$3,648)	0.19987	(\$729)
LTM, Years 2 and after (Annual)	Single Pay	33	(\$12,000)	(\$43,781)	0.19987	(\$8,751)

Solutia, TSR Cost Estimate

AOC:

Former Lot F Drum Disposal Area

Maximum or Most Conservative Estimate

Discount Rate = 5.0%  
Inflation Rate = 4.0%

Quarterly Cap Inspections	Single Pay	10	(\$10,000)	(\$14,802)	0.61391	(\$9,087)
Cap Repair Budget	Single Pay	10	(\$3,000)	(\$4,441)	0.61391	(\$2,726)
Institutional Controls, Check and Maintain	Single Pay	10	(\$1,000)	(\$1,480)	0.61391	(\$909)
LTM, Years 2 and after (Annual)	Single Pay	10	(\$12,000)	(\$17,763)	0.61391	(\$10,905)
Quarterly Cap Inspections	Single Pay	11	(\$10,000)	(\$15,395)	0.58468	(\$9,001)
Cap Repair Budget	Single Pay	11	(\$3,000)	(\$4,618)	0.58468	(\$2,700)
Institutional Controls, Check and Maintain	Single Pay	11	(\$1,000)	(\$1,539)	0.58468	(\$900)
LTM, Years 2 and after (Annual)	Single Pay	11	(\$12,000)	(\$18,473)	0.58468	(\$10,801)
Quarterly Cap Inspections	Single Pay	12	(\$10,000)	(\$16,010)	0.55684	(\$8,915)
Cap Repair Budget	Single Pay	12	(\$3,000)	(\$4,803)	0.55684	(\$2,675)
Institutional Controls, Check and Maintain	Single Pay	12	(\$1,000)	(\$1,601)	0.55684	(\$892)
LTM, Years 2 and after (Annual)	Single Pay	12	(\$12,000)	(\$19,212)	0.55684	(\$10,698)
Quarterly Cap Inspections	Single Pay	13	(\$10,000)	(\$16,651)	0.53032	(\$8,830)
Cap Repair Budget	Single Pay	13	(\$3,000)	(\$4,995)	0.53032	(\$2,649)
Institutional Controls, Check and Maintain	Single Pay	13	(\$1,000)	(\$1,665)	0.53032	(\$883)
LTM, Years 2 and after (Annual)	Single Pay	13	(\$12,000)	(\$19,981)	0.53032	(\$10,596)
Quarterly Cap Inspections	Single Pay	14	(\$10,000)	(\$17,317)	0.50507	(\$8,746)
Cap Repair Budget	Single Pay	14	(\$3,000)	(\$5,195)	0.50507	(\$2,624)
Institutional Controls, Check and Maintain	Single Pay	14	(\$1,000)	(\$1,732)	0.50507	(\$875)
LTM, Years 2 and after (Annual)	Single Pay	14	(\$12,000)	(\$20,780)	0.50507	(\$10,495)
Quarterly Cap Inspections	Single Pay	15	(\$10,000)	(\$18,009)	0.48102	(\$8,663)
Cap Repair Budget	Single Pay	15	(\$3,000)	(\$5,403)	0.48102	(\$2,599)
Institutional Controls, Check and Maintain	Single Pay	15	(\$1,000)	(\$1,801)	0.48102	(\$866)
LTM, Years 2 and after (Annual)	Single Pay	15	(\$12,000)	(\$21,611)	0.48102	(\$10,395)
Quarterly Cap Inspections	Single Pay	16	(\$10,000)	(\$18,730)	0.45811	(\$8,580)
Cap Repair Budget	Single Pay	16	(\$3,000)	(\$5,619)	0.45811	(\$2,574)
Institutional Controls, Check and Maintain	Single Pay	16	(\$1,000)	(\$1,873)	0.45811	(\$858)
LTM, Years 2 and after (Annual)	Single Pay	16	(\$12,000)	(\$22,476)	0.45811	(\$10,296)
Quarterly Cap Inspections	Single Pay	17	(\$10,000)	(\$19,479)	0.43630	(\$8,499)
Cap Repair Budget	Single Pay	17	(\$3,000)	(\$5,844)	0.43630	(\$2,550)
Institutional Controls, Check and Maintain	Single Pay	17	(\$1,000)	(\$1,948)	0.43630	(\$850)
LTM, Years 2 and after (Annual)	Single Pay	17	(\$12,000)	(\$23,375)	0.43630	(\$10,198)
Quarterly Cap Inspections	Single Pay	18	(\$10,000)	(\$20,258)	0.41552	(\$8,418)
Cap Repair Budget	Single Pay	18	(\$3,000)	(\$6,077)	0.41552	(\$2,525)
Institutional Controls, Check and Maintain	Single Pay	18	(\$1,000)	(\$2,026)	0.41552	(\$842)
LTM, Years 2 and after (Annual)	Single Pay	18	(\$12,000)	(\$24,310)	0.41552	(\$10,101)
Quarterly Cap Inspections	Single Pay	19	(\$10,000)	(\$21,068)	0.39573	(\$8,338)
Cap Repair Budget	Single Pay	19	(\$3,000)	(\$6,321)	0.39573	(\$2,501)
Institutional Controls, Check and Maintain	Single Pay	19	(\$1,000)	(\$2,107)	0.39573	(\$834)
LTM, Years 2 and after (Annual)	Single Pay	19	(\$12,000)	(\$25,282)	0.39573	(\$10,005)
Quarterly Cap Inspections	Single Pay	20	(\$10,000)	(\$21,911)	0.37689	(\$8,258)
Cap Repair Budget	Single Pay	20	(\$3,000)	(\$6,573)	0.37689	(\$2,477)
Institutional Controls, Check and Maintain	Single Pay	20	(\$1,000)	(\$2,191)	0.37689	(\$826)
LTM, Years 2 and after (Annual)	Single Pay	20	(\$12,000)	(\$26,293)	0.37689	(\$9,910)
Quarterly Cap Inspections	Single Pay	21	(\$10,000)	(\$22,788)	0.35894	(\$8,179)
Cap Repair Budget	Single Pay	21	(\$3,000)	(\$6,836)	0.35894	(\$2,454)
Institutional Controls, Check and Maintain	Single Pay	21	(\$1,000)	(\$2,279)	0.35894	(\$818)
LTM, Years 2 and after (Annual)	Single Pay	21	(\$12,000)	(\$27,345)	0.35894	(\$9,815)



Solutia, TSR Cost Estimate

AOC:

Former Lot F Drum Disposal Area

Maximum or Most Conservative Estimate

Discount Rate = 5.0%  
Inflation Rate = 4.0%

	Type	Year or Years	Cost	Escalated Cost	P-W Factor	Present Worth
<b>Capital Expenditures:</b>						
Additional Monitoring Wells (Install and Develop)	Single Pay	0.5	(\$25,000)	(\$25,495)	0.97590	(\$24,881)
Institutional Controls	Single Pay	0.5	(\$5,000)	(\$5,099)	0.97590	(\$4,976)
<b>Capital Expenditure Subtotal</b>						<b>(\$29,857)</b>
<b>Periodic Expenditures:</b>						
Quarterly Cap Inspections	Single Pay	1	(\$10,000)	(\$10,400)	0.95238	(\$9,905)
Cap Repair Budget	Single Pay	1	(\$3,000)	(\$3,120)	0.95238	(\$2,971)
Institutional Controls, Check and Maintain	Single Pay	1	(\$1,000)	(\$1,040)	0.95238	(\$990)
LTM, Years 1 and 2 (Semiannual)	Single Pay	1	(\$24,000)	(\$24,960)	0.95238	(\$23,771)
Quarterly Cap Inspections	Single Pay	2	(\$10,000)	(\$10,816)	0.90703	(\$9,810)
Cap Repair Budget	Single Pay	2	(\$3,000)	(\$3,245)	0.90703	(\$2,943)
Institutional Controls, Check and Maintain	Single Pay	2	(\$1,000)	(\$1,082)	0.90703	(\$981)
LTM, Years 1 and 2 (Semiannual)	Single Pay	2	(\$24,000)	(\$25,958)	0.90703	(\$23,545)
Quarterly Cap Inspections	Single Pay	3	(\$10,000)	(\$11,249)	0.86384	(\$9,717)
Cap Repair Budget	Single Pay	3	(\$3,000)	(\$3,375)	0.86384	(\$2,915)
Institutional Controls, Check and Maintain	Single Pay	3	(\$1,000)	(\$1,125)	0.86384	(\$972)
LTM, Years 2 and after (Annual)	Single Pay	3	(\$12,000)	(\$13,498)	0.86384	(\$11,660)
Quarterly Cap Inspections	Single Pay	4	(\$10,000)	(\$11,699)	0.82270	(\$9,624)
Cap Repair Budget	Single Pay	4	(\$3,000)	(\$3,510)	0.82270	(\$2,887)
Institutional Controls, Check and Maintain	Single Pay	4	(\$1,000)	(\$1,170)	0.82270	(\$962)
LTM, Years 2 and after (Annual)	Single Pay	4	(\$12,000)	(\$14,038)	0.82270	(\$11,549)
Quarterly Cap Inspections	Single Pay	5	(\$10,000)	(\$12,167)	0.78353	(\$9,533)
Cap Repair Budget	Single Pay	5	(\$3,000)	(\$3,650)	0.78353	(\$2,860)
Institutional Controls, Check and Maintain	Single Pay	5	(\$1,000)	(\$1,217)	0.78353	(\$953)
LTM, Years 2 and after (Annual)	Single Pay	5	(\$12,000)	(\$14,600)	0.78353	(\$11,439)
Quarterly Cap Inspections	Single Pay	6	(\$10,000)	(\$12,653)	0.74622	(\$9,442)
Cap Repair Budget	Single Pay	6	(\$3,000)	(\$3,796)	0.74622	(\$2,833)
Institutional Controls, Check and Maintain	Single Pay	6	(\$1,000)	(\$1,265)	0.74622	(\$944)
LTM, Years 2 and after (Annual)	Single Pay	6	(\$12,000)	(\$15,184)	0.74622	(\$11,330)
Quarterly Cap Inspections	Single Pay	7	(\$10,000)	(\$13,159)	0.71068	(\$9,352)
Cap Repair Budget	Single Pay	7	(\$3,000)	(\$3,948)	0.71068	(\$2,806)
Institutional Controls, Check and Maintain	Single Pay	7	(\$1,000)	(\$1,316)	0.71068	(\$935)
LTM, Years 2 and after (Annual)	Single Pay	7	(\$12,000)	(\$15,791)	0.71068	(\$11,222)
Quarterly Cap Inspections	Single Pay	8	(\$10,000)	(\$13,686)	0.67684	(\$9,263)
Cap Repair Budget	Single Pay	8	(\$3,000)	(\$4,106)	0.67684	(\$2,779)
Institutional Controls, Check and Maintain	Single Pay	8	(\$1,000)	(\$1,369)	0.67684	(\$926)
LTM, Years 2 and after (Annual)	Single Pay	8	(\$12,000)	(\$16,423)	0.67684	(\$11,116)
Quarterly Cap Inspections	Single Pay	9	(\$10,000)	(\$14,233)	0.64461	(\$9,175)
Cap Repair Budget	Single Pay	9	(\$3,000)	(\$4,270)	0.64461	(\$2,752)
Institutional Controls, Check and Maintain	Single Pay	9	(\$1,000)	(\$1,423)	0.64461	(\$917)
LTM, Years 2 and after (Annual)	Single Pay	9	(\$12,000)	(\$17,080)	0.64461	(\$11,010)



Solutia, TSR Cost Estimate

AOC:

Former Lot F Drum Disposal Area

Average or Most Probable Estimate

	Type	Year or Years	Cost	Escalated Cost	P-W Factor	Present Worth
Cap Repair Budget	Single Pay	8	(\$3,000)	(\$4,106)	0.67684	(\$2,779)
Institutional Controls, Check and Maintain	Single Pay	8	(\$1,000)	(\$1,369)	0.67684	(\$926)
LTM, Years 2 and after (Annual)	Single Pay	8	(\$12,000)	(\$16,423)	0.67684	(\$11,116)
Quarterly Cap Inspections	Single Pay	9	(\$10,000)	(\$14,233)	0.64461	(\$9,175)
Cap Repair Budget	Single Pay	9	(\$3,000)	(\$4,270)	0.64461	(\$2,752)
Institutional Controls, Check and Maintain	Single Pay	9	(\$1,000)	(\$1,423)	0.64461	(\$917)
LTM, Years 2 and after (Annual)	Single Pay	9	(\$12,000)	(\$17,080)	0.64461	(\$11,010)
Quarterly Cap Inspections	Single Pay	10	(\$10,000)	(\$14,802)	0.61391	(\$9,087)
Cap Repair Budget	Single Pay	10	(\$3,000)	(\$4,441)	0.61391	(\$2,726)
Institutional Controls, Check and Maintain	Single Pay	10	(\$1,000)	(\$1,480)	0.61391	(\$909)
LTM, Years 2 and after (Annual)	Single Pay	10	(\$12,000)	(\$17,763)	0.61391	(\$10,905)
Quarterly Cap Inspections	Single Pay	11	(\$10,000)	(\$15,395)	0.58468	(\$9,001)
Cap Repair Budget	Single Pay	11	(\$3,000)	(\$4,618)	0.58468	(\$2,700)
Institutional Controls, Check and Maintain	Single Pay	11	(\$1,000)	(\$1,539)	0.58468	(\$900)
LTM, Years 2 and after (Annual)	Single Pay	11	(\$12,000)	(\$18,473)	0.58468	(\$10,801)
Quarterly Cap Inspections	Single Pay	12	(\$10,000)	(\$16,010)	0.55684	(\$8,915)
Cap Repair Budget	Single Pay	12	(\$3,000)	(\$4,803)	0.55684	(\$2,675)
Institutional Controls, Check and Maintain	Single Pay	12	(\$1,000)	(\$1,601)	0.55684	(\$892)
LTM, Years 2 and after (Annual)	Single Pay	12	(\$12,000)	(\$19,212)	0.55684	(\$10,698)
Quarterly Cap Inspections	Single Pay	13	(\$10,000)	(\$16,651)	0.53032	(\$8,830)
Cap Repair Budget	Single Pay	13	(\$3,000)	(\$4,995)	0.53032	(\$2,649)
Institutional Controls, Check and Maintain	Single Pay	13	(\$1,000)	(\$1,665)	0.53032	(\$883)
LTM, Years 2 and after (Annual)	Single Pay	13	(\$12,000)	(\$19,981)	0.53032	(\$10,596)
Quarterly Cap Inspections	Single Pay	14	(\$10,000)	(\$17,317)	0.50507	(\$8,746)
Cap Repair Budget	Single Pay	14	(\$3,000)	(\$5,195)	0.50507	(\$2,624)
Institutional Controls, Check and Maintain	Single Pay	14	(\$1,000)	(\$1,732)	0.50507	(\$875)
LTM, Years 2 and after (Annual)	Single Pay	14	(\$12,000)	(\$20,780)	0.50507	(\$10,495)
Quarterly Cap Inspections	Single Pay	15	(\$10,000)	(\$18,009)	0.48102	(\$8,663)
Cap Repair Budget	Single Pay	15	(\$3,000)	(\$5,403)	0.48102	(\$2,599)
Institutional Controls, Check and Maintain	Single Pay	15	(\$1,000)	(\$1,801)	0.48102	(\$866)
LTM, Years 2 and after (Annual)	Single Pay	15	(\$12,000)	(\$21,611)	0.48102	(\$10,395)
Periodic Expenditure Subtotal						(\$385,225)
TOTAL PRESENT WORTH COST						(\$403,124)

Solutia, TSR Cost Estimate

AOC:

Former Lot F Drum Disposal Area

Average or Most Probable Estimate

	Type	Year or Years	Cost	Escalated Cost	P-W Factor	Present Worth
<b>Capital Expenditures:</b>						
Additional Monitoring Wells (Install and Develop)	Single Pay	0.5	(\$15,000)	(\$15,297)	0.97590	(\$14,928)
Institutional Controls	Single Pay	1.0	(\$3,000)	(\$3,120)	0.95238	(\$2,971)
<b>Capital Expenditure Subtotal</b>						<b>(\$17,900)</b>
<b>Periodic Expenditures:</b>						
Quarterly Cap Inspections	Single Pay	1	(\$10,000)	(\$10,400)	0.95238	(\$9,905)
Cap Repair Budget	Single Pay	1	(\$3,000)	(\$3,120)	0.95238	(\$2,971)
Institutional Controls, Check and Maintain	Single Pay	1	(\$1,000)	(\$1,040)	0.95238	(\$990)
LTM, Years 1 and 2 (Semiannual)	Single Pay	1	(\$24,000)	(\$24,960)	0.95238	(\$23,771)
Quarterly Cap Inspections	Single Pay	2	(\$10,000)	(\$10,816)	0.90703	(\$9,810)
Cap Repair Budget	Single Pay	2	(\$3,000)	(\$3,245)	0.90703	(\$2,943)
Institutional Controls, Check and Maintain	Single Pay	2	(\$1,000)	(\$1,082)	0.90703	(\$981)
LTM, Years 1 and 2 (Semiannual)	Single Pay	2	(\$24,000)	(\$25,958)	0.90703	(\$23,545)
Quarterly Cap Inspections	Single Pay	3	(\$10,000)	(\$11,249)	0.86384	(\$9,717)
Cap Repair Budget	Single Pay	3	(\$3,000)	(\$3,375)	0.86384	(\$2,915)
Institutional Controls, Check and Maintain	Single Pay	3	(\$1,000)	(\$1,125)	0.86384	(\$972)
LTM, Years 2 and after (Annual)	Single Pay	3	(\$12,000)	(\$13,498)	0.86384	(\$11,680)
Quarterly Cap Inspections	Single Pay	4	(\$10,000)	(\$11,699)	0.82270	(\$9,624)
Cap Repair Budget	Single Pay	4	(\$3,000)	(\$3,510)	0.82270	(\$2,887)
Institutional Controls, Check and Maintain	Single Pay	4	(\$1,000)	(\$1,170)	0.82270	(\$962)
LTM, Years 2 and after (Annual)	Single Pay	4	(\$12,000)	(\$14,038)	0.82270	(\$11,549)
Quarterly Cap Inspections	Single Pay	5	(\$10,000)	(\$12,167)	0.78353	(\$9,533)
Cap Repair Budget	Single Pay	5	(\$3,000)	(\$3,650)	0.78353	(\$2,860)
Institutional Controls, Check and Maintain	Single Pay	5	(\$1,000)	(\$1,217)	0.78353	(\$953)
LTM, Years 2 and after (Annual)	Single Pay	5	(\$12,000)	(\$14,600)	0.78353	(\$11,439)
Quarterly Cap Inspections	Single Pay	6	(\$10,000)	(\$12,653)	0.74622	(\$9,442)
Cap Repair Budget	Single Pay	6	(\$3,000)	(\$3,796)	0.74622	(\$2,833)
Institutional Controls, Check and Maintain	Single Pay	6	(\$1,000)	(\$1,265)	0.74622	(\$944)
LTM, Years 2 and after (Annual)	Single Pay	6	(\$12,000)	(\$15,184)	0.74622	(\$11,330)
Quarterly Cap Inspections	Single Pay	7	(\$10,000)	(\$13,159)	0.71068	(\$9,352)
Cap Repair Budget	Single Pay	7	(\$3,000)	(\$3,948)	0.71068	(\$2,806)
Institutional Controls, Check and Maintain	Single Pay	7	(\$1,000)	(\$1,316)	0.71068	(\$935)
LTM, Years 2 and after (Annual)	Single Pay	7	(\$12,000)	(\$15,791)	0.71068	(\$11,222)
Quarterly Cap Inspections	Single Pay	8	(\$10,000)	(\$13,686)	0.67684	(\$9,263)

Solutia, TSR Cost Estimate

AOC:

Former Lot F Drum Disposal Area

Cost Item	"Average" or "Most Probable" Estimate				"Maximum" or "Most Conservative" Estimate			
	Estimated Quantity	Units	Unit Cost	Extended Cost	Estimated Quantity	Units	Unit Cost	Extended Cost
<i>Capital Cost</i>								
Additional Monitoring Wells (Install and Develop)	3	wells	\$5,000	\$15,000	5	wells	\$5,000.00	\$25,000
Institutional Controls	NA	NA	NA	\$3,000	NA	NA	NA	\$5,000
<i>Operation and Maintenance (Annual)</i>								
Quarterly Cap Inspections	4	inspections	\$2,500	\$10,000	4	inspections	\$2,500	\$10,000
Cap Repair Budget	NA	NA	NA	\$3,000	NA	NA	NA	\$8,000
Institutional Controls, Check and Maintain	NA	NA	NA	\$1,000	NA	NA	NA	\$1,000
<i>Long-Term Monitoring</i>								
LTM, Years 1 and 2 (Semiannual)	8	well-events	\$3,000	\$24,000	12	well-events	\$3,000.00	\$36,000
LTM, Years 2 and after (Annual)	4	well-events	\$3,000	\$12,000	6	well-events	\$3,000.00	\$18,000



### Solutia, TSR Cost Estimate

AOC:

Former Chlor-Alkali Production Area

**Maximum or Most Conservative Estimate**

Discount Rate = 5.0%

Inflation Rate = 4.0%

	Type	Year or Years	Cost	Escalated Cost	P-W Factor	Present Worth
<b>Capital Expenditures:</b>						
Excavation	Single Pay	0.5	(\$11,295)	(\$11,519)	0.97590	(\$11,241)
Transportation and Disposal, Hg-contaminated soil	Single Pay	0.5	(\$14,400)	(\$14,685)	0.97590	(\$14,331)
Transportation and Disposal, VOC-contaminated soil	Single Pay	0.5	(\$241,200)	(\$245,977)	0.97590	(\$240,049)
Confirmatory Sampling	Single Pay	1.0	(\$25,000)	(\$26,000)	0.95238	(\$24,762)
				<b>Capital Expenditure Subtotal</b>		<b>(\$290,383)</b>
<b>Periodic Expenditures:</b>						
Not applicable				<b>Periodic Expenditure Subtotal</b>		\$ -
				<b>TOTAL PRESENT WORTH COST</b>		<b>(\$290,383)</b>

Former Chlor-Alkali Production Area

**Average or Most Probable Estimate**

Discount rate =

5.0%

Inflation Rate =

4.0%

	Type	Year or Years	Cost	Escalated Cost	P-W Factor	Present Worth
<b>Capital Expenditures:</b>						
Excavation	Single Pay	0.5	(\$7,530)	(\$7,679)	0.97590	(\$7,494)
Transportation and Disposal, Hg-contaminated soil	Single Pay	0.5	(\$9,600)	(\$9,790)	0.97590	(\$9,554)
Transportation and Disposal, VOC-contaminated soil	Single Pay	0.5	(\$144,720)	(\$147,586)	0.97590	(\$144,029)
Confirmatory Sampling	Single Pay	1.0	(\$15,000)	(\$15,600)	0.95238	(\$14,857)
				<b>Capital Expenditure Subtotal</b>		<b>(\$175,935)</b>
<b>Periodic Expenditures:</b>						
Not applicable						
				<b>Periodic Expenditure Subtotal</b>		<b>\$ -</b>
				<b>TOTAL PRESENT WORTH COST</b>		<b>(\$175,935)</b>

AOC:

### "Average" or "Most Probable" Estimate

Cost Item	Estimated Quantity	Units	Unit Cost	Extended Cost	Estimated Quantity	Units	Unit Cost	Extended Cost
<i>Capital Cost</i>								
Excavation	753	CY	\$10	\$7,530	753	CY	\$15	\$11,295
Transportation and Disposal, Hg-contaminated soil	240	tons	\$40	\$9,600	240	tons	\$60	\$14,400
Transportation and Disposal, VOC-contaminated soil	965	tons	\$150	\$144,720	965	tons	\$250	\$241,200
Confirmatory Sampling	NA	NA	NA	\$15,000	NA	NA	NA	\$25,000

Covered under estimate for the MHU/DHU

Covered under estimate for the MHU/DHU



AOC: Former Chlorobenzene Process Area

AOC: Former Chlorobenzene Process Area

Discount Rate = 5.0%  
Inflation Rate = 4.0%

	Type	Year or Years	Cost	Escalated Cost	P-W Factor	Present Worth
<b>Capital Expenditures:</b>						
ISTD Pilot Test	Single Pay	0.5	(\$350,000)	(\$356,931)	0.97590	(\$348,329)
ISTD Full-Scale	Single Pay	1.5	(\$3,978,000)	(\$4,219,051)	0.92943	(\$3,921,307)
Engineering Design	Single Pay	1.0	(\$994,500)	(\$1,034,280)	0.95238	(\$985,029)
Confirmatory Sampling	Single Pay	2.0	(\$150,000)	(\$162,240)	0.90703	(\$147,156)
Institutional Controls	Single Pay	2.0	(\$50,000)	(\$54,080)	0.90703	(\$49,052)
Construction Cost Contingency	Single Pay	1.0	(\$397,800)	(\$413,712)	0.95238	(\$394,011)
				<b>Capital Expenditure Subtotal</b>		<b>(\$5,844,885)</b>
<b>Periodic Expenditures:</b>						
Not applicable						
				<b>Periodic Expenditure Subtotal</b>		<b>\$ -</b>
				<b>TOTAL PRESENT WORTH COST</b>		<b>(\$5,844,885)</b>

AOC: Former Chlorobenzene Process Area

Discount rate = 5.0%  
Inflation Rate = 4.0%

	Type	Year or Years	Cost	Escalated Cost	P-W Factor	Present Worth
<b>Capital Expenditures:</b>						
ISTD Pilot Test	Single Pay	0.5	(\$200,000)	(\$203,961)	0.97590	(\$199,045)
ISTD Full-Scale	Single Pay	1.5	(\$3,060,000)	(\$3,245,424)	0.92943	(\$3,016,390)
Engineering Design	Single Pay	1.0	(\$765,000)	(\$795,600)	0.95238	(\$757,714)
Confirmatory Sampling	Single Pay	2.0	(\$100,000)	(\$108,160)	0.90703	(\$98,104)
Institutional Controls	Single Pay	2.0	(\$30,000)	(\$32,448)	0.90703	(\$29,431)
Construction Cost Contingency	Single Pay	1.0	(\$306,000)	(\$318,240)	0.95238	(\$303,086)
				<b>Capital Expenditure Subtotal</b>		<b>(\$4,403,771)</b>
<b>Periodic Expenditures:</b>						
Not applicable						
				<b>Periodic Expenditure Subtotal</b>		<b>\$ -</b>
				<b>TOTAL PRESENT WORTH COST</b>		<b>(\$4,403,771)</b>

AOC:

### "Average" or "Most Probable" Estimate

"Maximum" or "Most Conservative" Estimate

### Operation and Maintenance

Covered under estimate for the MHU/DHU

### Long-Term Monitoring

Covered under estimate for the MHU/DHU



AOC:

**Maximum or Most Conservative Estimate**

Inflation Rate = 4.0%

	Type	Year or Years	Cost	Escalated Cost	P-W Factor	Present Worth
<b>Capital Expenditures:</b>						
ISTD Pilot Test	Single Pay	0.5	(\$400,000)	(\$407,922)	0.97590	(\$398,091)
ISTD Full-Scale	Single Pay	1.5	(\$27,200,000)	(\$28,848,213)	0.92943	(\$26,812,355)
Engineering Design	Single Pay	1.0	(\$4,080,000)	(\$4,243,200)	0.95238	(\$4,041,143)
Confirmatory Sampling	Single Pay	2.0	(\$100,000)	(\$108,160)	0.90703	(\$98,104)
Institutional Controls	Single Pay	2.0	(\$40,000)	(\$43,264)	0.90703	(\$39,242)
Construction Cost Contingency	Single Pay	1.0	(\$2,720,000)	(\$2,828,800)	0.95238	(\$2,694,095)
				<b>Capital Expenditure Subtotal</b>		<b>(\$34,083,030)</b>
<b>Periodic Expenditures:</b>						
Not applicable						
				<b>Periodic Expenditure Subtotal</b>		<b>\$ -</b>
				<b>TOTAL PRESENT WORTH COST</b>		<b>(\$34,083,030)</b>

AOC:

**Average or Most Probable Estimate**

Inflation Rate = 4.0%

	Type	Year or Years	Cost	Escalated Cost	P-W Factor	Present Worth
<b>Capital Expenditures:</b>						
ISTD Pilot Test	Single Pay	0.5	(\$250,000)	(\$254,951)	0.97590	(\$248,807)
ISTD Full-Scale	Single Pay	1.5	(\$13,900,000)	(\$14,742,285)	0.92943	(\$13,701,902)
Engineering Design	Single Pay	1.0	(\$2,085,000)	(\$2,168,400)	0.95238	(\$2,065,143)
Confirmatory Sampling	Single Pay	2.0	(\$75,000)	(\$81,120)	0.90703	(\$73,578)
Institutional Controls	Single Pay	2.0	(\$25,000)	(\$27,040)	0.90703	(\$24,526)
Construction Cost Contingency	Single Pay	1.0	(\$1,390,000)	(\$1,445,600)	0.95238	(\$1,376,762)
				<b>Capital Expenditure Subtotal</b>		<b>(\$17,490,718)</b>
<b>Periodic Expenditures:</b>						
Not applicable				<b>Periodic Expenditure Subtotal</b>		<b>\$ -</b>
				<b>TOTAL PRESENT WORTH COST</b>		<b>(\$17,490,718)</b>





Solutia, TSR Cost Estimate

AOC: MHU and DHU  
Maximum or Most Conservative Estimate (Without GMCS O&M)

Discount Rate = 5.0%  
 Inflation Rate = 4.0%

	Type	Year or Years	Cost	Escalated Cost	P-W Factor	Present Worth
<b>Capital Expenditures:</b>						
Additional Wells, Install and Develop	Single Pay	0.5	(\$112,500)	(\$114,728)	0.97590	(\$111,963)
			<b>Capital Expenditure Subtotal</b>			<b>(\$111,963)</b>
<b>Periodic Expenditures:</b>						
Institutional Controls, Check and Maintain	Single Pay	1	(\$1,500)	(\$1,560)	0.95238	(\$1,486)
LTGM, First Two Years (Quarterly)	Single Pay	1	(\$420,000)	(\$436,800)	0.95238	(\$416,000)
Institutional Controls, Check and Maintain	Single Pay	2	(\$1,500)	(\$1,622)	0.90703	(\$1,472)
LTGM, First Two Years (Quarterly)	Single Pay	2	(\$420,000)	(\$454,272)	0.90703	(\$412,038)
Sediment/Surface Water Sampling (Biennial)	Single Pay	2	(\$100,000)	(\$108,160)	0.90703	(\$98,104)
Institutional Controls, Check and Maintain	Single Pay	3	(\$1,500)	(\$1,687)	0.86384	(\$1,458)
LTGM, Years 3-10 (Semi-Annual)	Single Pay	3	(\$210,000)	(\$236,221)	0.86384	(\$204,057)
Institutional Controls, Check and Maintain	Single Pay	4	(\$1,500)	(\$1,755)	0.82270	(\$1,444)
LTGM, Years 3-10 (Semi-Annual)	Single Pay	4	(\$210,000)	(\$245,670)	0.82270	(\$202,114)
Sediment/Surface Water Sampling (Biennial)	Single Pay	4	(\$100,000)	(\$116,986)	0.82270	(\$96,245)
Institutional Controls, Check and Maintain	Single Pay	5	(\$1,500)	(\$1,825)	0.78353	(\$1,430)
LTGM, Years 3-10 (Semi-Annual)	Single Pay	5	(\$210,000)	(\$255,497)	0.78353	(\$200,189)
Institutional Controls, Check and Maintain	Single Pay	6	(\$1,500)	(\$1,898)	0.74622	(\$1,416)
LTGM, Years 3-10 (Semi-Annual)	Single Pay	6	(\$210,000)	(\$265,717)	0.74622	(\$198,282)
Sediment/Surface Water Sampling (Biennial)	Single Pay	6	(\$100,000)	(\$126,532)	0.74622	(\$94,420)
Institutional Controls, Check and Maintain	Single Pay	7	(\$1,500)	(\$1,974)	0.71068	(\$1,403)
LTGM, Years 3-10 (Semi-Annual)	Single Pay	7	(\$210,000)	(\$276,346)	0.71068	(\$196,394)
Institutional Controls, Check and Maintain	Single Pay	8	(\$1,500)	(\$2,053)	0.67684	(\$1,389)
LTGM, Years 3-10 (Semi-Annual)	Single Pay	8	(\$210,000)	(\$287,400)	0.67684	(\$194,523)
Sediment/Surface Water Sampling (Biennial)	Single Pay	8	(\$100,000)	(\$136,857)	0.67684	(\$92,630)
Institutional Controls, Check and Maintain	Single Pay	9	(\$1,500)	(\$2,135)	0.64461	(\$1,376)
LTGM, Years 3-10 (Semi-Annual)	Single Pay	9	(\$210,000)	(\$298,895)	0.64461	(\$192,671)
Institutional Controls, Check and Maintain	Single Pay	10	(\$1,500)	(\$2,220)	0.61391	(\$1,363)
LTGM, Years 3-10 (Semi-Annual)	Single Pay	10	(\$210,000)	(\$310,851)	0.61391	(\$190,836)
Sediment/Surface Water Sampling (Biennial)	Single Pay	10	(\$100,000)	(\$148,024)	0.61391	(\$90,874)
Institutional Controls, Check and Maintain	Single Pay	11	(\$1,500)	(\$2,309)	0.58468	(\$1,350)
LTGM, Year 11 and Later (Annual)	Single Pay	11	(\$105,000)	(\$161,643)	0.58468	(\$94,509)
Institutional Controls, Check and Maintain	Single Pay	12	(\$1,500)	(\$2,402)	0.55684	(\$1,337)
LTGM, Year 11 and Later (Annual)	Single Pay	12	(\$105,000)	(\$168,108)	0.55684	(\$93,609)
Sediment/Surface Water Sampling (Biennial)	Single Pay	12	(\$100,000)	(\$160,103)	0.55684	(\$89,151)
Institutional Controls, Check and Maintain	Single Pay	13	(\$1,500)	(\$2,498)	0.53032	(\$1,325)
LTGM, Year 11 and Later (Annual)	Single Pay	13	(\$105,000)	(\$174,833)	0.53032	(\$92,718)

Solutia, TSR Cost Estimate

AOC: MHU and DHU  
Maximum or Most Conservative Estimate (Without GMCS O&M)

Discount Rate = 5.0%  
 Inflation Rate = 4.0%

Institutional Controls, Check and Maintain	Single Pay	14	(\$1,500)	(\$2,598)	0.50507	(\$1,312)
LTGM, Year 11 and Later (Annual)	Single Pay	14	(\$105,000)	(\$181,826)	0.50507	(\$91,834)
Sediment/Surface Water Sampling (Biennial)	Single Pay	14	(\$100,000)	(\$173,168)	0.50507	(\$87,461)
Institutional Controls, Check and Maintain	Single Pay	15	(\$1,500)	(\$2,701)	0.48102	(\$1,299)
LTGM, Year 11 and Later (Annual)	Single Pay	15	(\$105,000)	(\$189,099)	0.48102	(\$90,960)
Institutional Controls, Check and Maintain	Single Pay	16	(\$1,500)	(\$2,809)	0.45811	(\$1,287)
LTGM, Year 11 and Later (Annual)	Single Pay	16	(\$105,000)	(\$196,663)	0.45811	(\$90,094)
Sediment/Surface Water Sampling (Biennial)	Single Pay	16	(\$100,000)	(\$187,298)	0.45811	(\$85,803)
Institutional Controls, Check and Maintain	Single Pay	17	(\$1,500)	(\$2,922)	0.43630	(\$1,275)
LTGM, Year 11 and Later (Annual)	Single Pay	17	(\$105,000)	(\$204,530)	0.43630	(\$89,236)
Institutional Controls, Check and Maintain	Single Pay	18	(\$1,500)	(\$3,039)	0.41552	(\$1,263)
LTGM, Year 11 and Later (Annual)	Single Pay	18	(\$105,000)	(\$212,711)	0.41552	(\$88,386)
Sediment/Surface Water Sampling (Biennial)	Single Pay	18	(\$100,000)	(\$202,582)	0.41552	(\$84,177)
Institutional Controls, Check and Maintain	Single Pay	19	(\$1,500)	(\$3,160)	0.39573	(\$1,251)
LTGM, Year 11 and Later (Annual)	Single Pay	19	(\$105,000)	(\$221,219)	0.39573	(\$87,544)
Institutional Controls, Check and Maintain	Single Pay	20	(\$1,500)	(\$3,287)	0.37689	(\$1,239)
LTGM, Year 11 and Later (Annual)	Single Pay	20	(\$105,000)	(\$230,068)	0.37689	(\$86,710)
Sediment/Surface Water Sampling (Biennial)	Single Pay	20	(\$100,000)	(\$219,112)	0.37689	(\$82,581)
Institutional Controls, Check and Maintain	Single Pay	21	(\$1,500)	(\$3,418)	0.35894	(\$1,227)
LTGM, Year 11 and Later (Annual)	Single Pay	21	(\$105,000)	(\$239,271)	0.35894	(\$85,884)
Institutional Controls, Check and Maintain	Single Pay	22	(\$1,500)	(\$3,555)	0.34185	(\$1,215)
LTGM, Year 11 and Later (Annual)	Single Pay	22	(\$105,000)	(\$248,841)	0.34185	(\$85,066)
Sediment/Surface Water Sampling (Biennial)	Single Pay	22	(\$100,000)	(\$236,992)	0.34185	(\$81,016)
Institutional Controls, Check and Maintain	Single Pay	23	(\$1,500)	(\$3,697)	0.32557	(\$1,204)
LTGM, Year 11 and Later (Annual)	Single Pay	23	(\$105,000)	(\$258,795)	0.32557	(\$84,256)
Institutional Controls, Check and Maintain	Single Pay	24	(\$1,500)	(\$3,845)	0.31007	(\$1,192)
LTGM, Year 11 and Later (Annual)	Single Pay	24	(\$105,000)	(\$269,147)	0.31007	(\$83,454)
Sediment/Surface Water Sampling (Biennial)	Single Pay	24	(\$100,000)	(\$256,330)	0.31007	(\$79,480)
Institutional Controls, Check and Maintain	Single Pay	25	(\$1,500)	(\$3,999)	0.29530	(\$1,181)
LTGM, Year 11 and Later (Annual)	Single Pay	25	(\$105,000)	(\$279,913)	0.29530	(\$82,659)
Institutional Controls, Check and Maintain	Single Pay	26	(\$1,500)	(\$4,159)	0.28124	(\$1,170)
LTGM, Year 11 and Later (Annual)	Single Pay	26	(\$105,000)	(\$291,109)	0.28124	(\$81,872)
Sediment/Surface Water Sampling (Biennial)	Single Pay	26	(\$100,000)	(\$277,247)	0.28124	(\$77,973)
Institutional Controls, Check and Maintain	Single Pay	27	(\$1,500)	(\$4,325)	0.26785	(\$1,158)
LTGM, Year 11 and Later (Annual)	Single Pay	27	(\$105,000)	(\$302,754)	0.26785	(\$81,092)
Institutional Controls, Check and Maintain	Single Pay	28	(\$1,500)	(\$4,498)	0.25509	(\$1,147)
LTGM, Year 11 and Later (Annual)	Single Pay	28	(\$105,000)	(\$314,864)	0.25509	(\$80,320)
Sediment/Surface Water Sampling (Biennial)	Single Pay	28	(\$100,000)	(\$299,870)	0.25509	(\$76,495)
Institutional Controls, Check and Maintain	Single Pay	29	(\$1,500)	(\$4,678)	0.24295	(\$1,136)



Solutia, TSR Cost Estimate

AOC: MHU and DHU  
Maximum or Most Conservative Estimate (Without GMCS O&M)

Discount Rate = 5.0%  
 Inflation Rate = 4.0%

LTGM, Year 11 and Later (Annual)	Single Pay	29	(\$105,000)	(\$327,458)	0.24295	(\$79,555)
Institutional Controls, Check and Maintain	Single Pay	30	(\$1,500)	(\$4,865)	0.23138	(\$1,126)
LTGM, Year 11 and Later (Annual)	Single Pay	30	(\$105,000)	(\$340,557)	0.23138	(\$78,797)
Sediment/Surface Water Sampling (Biennial)	Single Pay	30	(\$100,000)	(\$324,340)	0.23138	(\$75,045)
Institutional Controls, Check and Maintain	Single Pay	31	(\$1,500)	(\$5,060)	0.22036	(\$1,115)
LTGM, Year 11 and Later (Annual)	Single Pay	31	(\$105,000)	(\$354,179)	0.22036	(\$78,047)
Institutional Controls, Check and Maintain	Single Pay	32	(\$1,500)	(\$5,262)	0.20987	(\$1,104)
LTGM, Year 11 and Later (Annual)	Single Pay	32	(\$105,000)	(\$368,346)	0.20987	(\$77,303)
Sediment/Surface Water Sampling (Biennial)	Single Pay	32	(\$100,000)	(\$350,806)	0.20987	(\$73,622)
Institutional Controls, Check and Maintain	Single Pay	33	(\$1,500)	(\$5,473)	0.19987	(\$1,094)
LTGM, Year 11 and Later (Annual)	Single Pay	33	(\$105,000)	(\$383,080)	0.19987	(\$76,567)
Institutional Controls, Check and Maintain	Single Pay	34	(\$1,500)	(\$5,691)	0.19035	(\$1,083)
LTGM, Year 11 and Later (Annual)	Single Pay	34	(\$105,000)	(\$398,403)	0.19035	(\$75,838)
Sediment/Surface Water Sampling (Biennial)	Single Pay	34	(\$100,000)	(\$379,432)	0.19035	(\$72,227)
Institutional Controls, Check and Maintain	Single Pay	35	(\$1,500)	(\$5,919)	0.18129	(\$1,073)
LTGM, Year 11 and Later (Annual)	Single Pay	35	(\$105,000)	(\$414,339)	0.18129	(\$75,116)
Institutional Controls, Check and Maintain	Single Pay	36	(\$1,500)	(\$6,156)	0.17266	(\$1,063)
LTGM, Year 11 and Later (Annual)	Single Pay	36	(\$105,000)	(\$430,913)	0.17266	(\$74,400)
Sediment/Surface Water Sampling (Biennial)	Single Pay	36	(\$100,000)	(\$410,393)	0.17266	(\$70,857)
Institutional Controls, Check and Maintain	Single Pay	37	(\$1,500)	(\$6,402)	0.16444	(\$1,053)
LTGM, Year 11 and Later (Annual)	Single Pay	37	(\$105,000)	(\$448,149)	0.16444	(\$73,692)
Institutional Controls, Check and Maintain	Single Pay	38	(\$1,500)	(\$6,658)	0.15661	(\$1,043)
LTGM, Year 11 and Later (Annual)	Single Pay	38	(\$105,000)	(\$466,075)	0.15661	(\$72,990)
Sediment/Surface Water Sampling (Biennial)	Single Pay	38	(\$100,000)	(\$443,881)	0.15661	(\$69,514)
Institutional Controls, Check and Maintain	Single Pay	39	(\$1,500)	(\$6,925)	0.14915	(\$1,033)
LTGM, Year 11 and Later (Annual)	Single Pay	39	(\$105,000)	(\$484,718)	0.14915	(\$72,295)
Institutional Controls, Check and Maintain	Single Pay	40	(\$1,500)	(\$7,202)	0.14205	(\$1,023)
LTGM, Year 11 and Later (Annual)	Single Pay	40	(\$105,000)	(\$504,107)	0.14205	(\$71,606)
Sediment/Surface Water Sampling (Biennial)	Single Pay	40	(\$100,000)	(\$480,102)	0.14205	(\$68,196)
Institutional Controls, Check and Maintain	Single Pay	41	(\$1,500)	(\$7,490)	0.13528	(\$1,013)
LTGM, Year 11 and Later (Annual)	Single Pay	41	(\$105,000)	(\$524,271)	0.13528	(\$70,924)
Institutional Controls, Check and Maintain	Single Pay	42	(\$1,500)	(\$7,789)	0.12884	(\$1,004)
LTGM, Year 11 and Later (Annual)	Single Pay	42	(\$105,000)	(\$545,242)	0.12884	(\$70,249)
Sediment/Surface Water Sampling (Biennial)	Single Pay	42	(\$100,000)	(\$519,278)	0.12884	(\$66,904)
Institutional Controls, Check and Maintain	Single Pay	43	(\$1,500)	(\$8,101)	0.12270	(\$994)
LTGM, Year 11 and Later (Annual)	Single Pay	43	(\$105,000)	(\$567,052)	0.12270	(\$69,580)
Institutional Controls, Check and Maintain	Single Pay	44	(\$1,500)	(\$8,425)	0.11686	(\$985)
LTGM, Year 11 and Later (Annual)	Single Pay	44	(\$105,000)	(\$589,734)	0.11686	(\$68,917)
Sediment/Surface Water Sampling (Biennial)	Single Pay	44	(\$100,000)	(\$561,652)	0.11686	(\$65,635)



Solutia, TSR Cost Estimate

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Maximum or Most Conservative Estimate (Without GMCS O&M)

Discount Rate = 5.0%  
 Inflation Rate = 4.0%

Institutional Controls, Check and Maintain	Single Pay	45	(\$1,500)	(\$8,762)	0.11130	(\$975)
LTGM, Year 11 and Later (Annual)	Single Pay	45	(\$105,000)	(\$613,323)	0.11130	(\$68,261)
Institutional Controls, Check and Maintain	Single Pay	46	(\$1,500)	(\$9,112)	0.10600	(\$966)
LTGM, Year 11 and Later (Annual)	Single Pay	46	(\$105,000)	(\$637,856)	0.10600	(\$67,611)
Sediment/Surface Water Sampling (Biennial)	Single Pay	46	(\$100,000)	(\$607,482)	0.10600	(\$64,391)
Institutional Controls, Check and Maintain	Single Pay	47	(\$1,500)	(\$9,477)	0.10095	(\$957)
LTGM, Year 11 and Later (Annual)	Single Pay	47	(\$105,000)	(\$663,371)	0.10095	(\$66,967)
Institutional Controls, Check and Maintain	Single Pay	48	(\$1,500)	(\$9,856)	0.09614	(\$948)
LTGM, Year 11 and Later (Annual)	Single Pay	48	(\$105,000)	(\$689,905)	0.09614	(\$66,329)
Sediment/Surface Water Sampling (Biennial)	Single Pay	48	(\$100,000)	(\$657,053)	0.09614	(\$63,170)
Institutional Controls, Check and Maintain	Single Pay	49	(\$1,500)	(\$10,250)	0.09156	(\$939)
LTGM, Year 11 and Later (Annual)	Single Pay	49	(\$105,000)	(\$717,502)	0.09156	(\$65,697)
Institutional Controls, Check and Maintain	Single Pay	50	(\$1,500)	(\$10,660)	0.08720	(\$930)
LTGM, Year 11 and Later (Annual)	Single Pay	50	(\$105,000)	(\$746,202)	0.08720	(\$65,072)
Sediment/Surface Water Sampling (Biennial)	Single Pay	50	(\$100,000)	(\$710,668)	0.08720	(\$61,973)
Institutional Controls, Check and Maintain	Single Pay	51	(\$1,500)	(\$11,086)	0.08305	(\$921)
LTGM, Year 11 and Later (Annual)	Single Pay	51	(\$105,000)	(\$776,050)	0.08305	(\$64,452)
Institutional Controls, Check and Maintain	Single Pay	52	(\$1,500)	(\$11,530)	0.07910	(\$912)
LTGM, Year 11 and Later (Annual)	Single Pay	52	(\$105,000)	(\$807,092)	0.07910	(\$63,838)
Sediment/Surface Water Sampling (Biennial)	Single Pay	52	(\$100,000)	(\$768,659)	0.07910	(\$60,798)
Institutional Controls, Check and Maintain	Single Pay	53	(\$1,500)	(\$11,991)	0.07533	(\$903)
LTGM, Year 11 and Later (Annual)	Single Pay	53	(\$105,000)	(\$839,375)	0.07533	(\$63,230)
Institutional Controls, Check and Maintain	Single Pay	54	(\$1,500)	(\$12,471)	0.07174	(\$895)
LTGM, Year 11 and Later (Annual)	Single Pay	54	(\$105,000)	(\$872,951)	0.07174	(\$62,628)
Sediment/Surface Water Sampling (Biennial)	Single Pay	54	(\$100,000)	(\$831,381)	0.07174	(\$59,646)
Institutional Controls, Check and Maintain	Single Pay	55	(\$1,500)	(\$12,970)	0.06833	(\$886)
LTGM, Year 11 and Later (Annual)	Single Pay	55	(\$105,000)	(\$907,869)	0.06833	(\$62,031)
Institutional Controls, Check and Maintain	Single Pay	56	(\$1,500)	(\$13,488)	0.06507	(\$878)
LTGM, Year 11 and Later (Annual)	Single Pay	56	(\$105,000)	(\$944,183)	0.06507	(\$61,441)
Sediment/Surface Water Sampling (Biennial)	Single Pay	56	(\$100,000)	(\$899,222)	0.06507	(\$58,515)
Institutional Controls, Check and Maintain	Single Pay	57	(\$1,500)	(\$14,028)	0.06197	(\$869)
LTGM, Year 11 and Later (Annual)	Single Pay	57	(\$105,000)	(\$981,951)	0.06197	(\$60,855)
Institutional Controls, Check and Maintain	Single Pay	58	(\$1,500)	(\$14,589)	0.05902	(\$861)
LTGM, Year 11 and Later (Annual)	Single Pay	58	(\$105,000)	(\$1,021,229)	0.05902	(\$60,276)
Sediment/Surface Water Sampling (Biennial)	Single Pay	58	(\$100,000)	(\$972,599)	0.05902	(\$57,406)
Institutional Controls, Check and Maintain	Single Pay	59	(\$1,500)	(\$15,173)	0.05621	(\$853)
LTGM, Year 11 and Later (Annual)	Single Pay	59	(\$105,000)	(\$1,062,078)	0.05621	(\$59,702)
Institutional Controls, Check and Maintain	Single Pay	60	(\$1,500)	(\$15,779)	0.05354	(\$845)
LTGM, Year 11 and Later (Annual)	Single Pay	60	(\$105,000)	(\$1,104,561)	0.05354	(\$59,133)
Sediment/Surface Water Sampling (Biennial)	Single Pay	60	(\$100,000)	(\$1,051,963)	0.05354	(\$58,317)
Periodic Expenditure Subtotal						(\$8,509,476)
TOTAL PRESENT WORTH COST						(\$8,621,439)

Solutia, TSR Cost Estimate

AOC:

MHU and DHU

Average or Most Probable Estimate (Without GMCS O&M)

Discount Rate = 5.0%

Inflation Rate = 4.0%

LTGM, Year 11 and Later (Annual)	Single Pay	28	(\$75,000)	(\$224,903)	0.25509	(\$57,371)
Sediment/Surface Water Sampling (Biennial)	Single Pay	28	(\$60,000)	(\$179,922)	0.25509	(\$45,897)
Institutional Controls, Check and Maintain	Single Pay	29	(\$1,500)	(\$4,678)	0.24295	(\$1,136)
LTGM, Year 11 and Later (Annual)	Single Pay	29	(\$75,000)	(\$233,899)	0.24295	(\$56,825)
Institutional Controls, Check and Maintain	Single Pay	30	(\$1,500)	(\$4,865)	0.23138	(\$1,126)
LTGM, Year 11 and Later (Annual)	Single Pay	30	(\$75,000)	(\$243,255)	0.23138	(\$56,284)
Sediment/Surface Water Sampling (Biennial)	Single Pay	30	(\$60,000)	(\$194,604)	0.23138	(\$45,027)
Institutional Controls, Check and Maintain	Single Pay	31	(\$1,500)	(\$5,060)	0.22036	(\$1,115)
LTGM, Year 11 and Later (Annual)	Single Pay	31	(\$75,000)	(\$252,985)	0.22036	(\$55,748)
Institutional Controls, Check and Maintain	Single Pay	32	(\$1,500)	(\$5,262)	0.20987	(\$1,104)
LTGM, Year 11 and Later (Annual)	Single Pay	32	(\$75,000)	(\$263,104)	0.20987	(\$55,217)
Sediment/Surface Water Sampling (Biennial)	Single Pay	32	(\$60,000)	(\$210,484)	0.20987	(\$44,173)
Institutional Controls, Check and Maintain	Single Pay	33	(\$1,500)	(\$5,473)	0.19987	(\$1,094)
LTGM, Year 11 and Later (Annual)	Single Pay	33	(\$75,000)	(\$273,629)	0.19987	(\$54,691)
Institutional Controls, Check and Maintain	Single Pay	34	(\$1,500)	(\$5,691)	0.19035	(\$1,083)
LTGM, Year 11 and Later (Annual)	Single Pay	34	(\$75,000)	(\$284,574)	0.19035	(\$54,170)
Sediment/Surface Water Sampling (Biennial)	Single Pay	34	(\$60,000)	(\$227,659)	0.19035	(\$43,336)
Institutional Controls, Check and Maintain	Single Pay	35	(\$1,500)	(\$5,919)	0.18129	(\$1,073)
LTGM, Year 11 and Later (Annual)	Single Pay	35	(\$75,000)	(\$295,957)	0.18129	(\$53,654)
Institutional Controls, Check and Maintain	Single Pay	36	(\$1,500)	(\$6,156)	0.17266	(\$1,063)
LTGM, Year 11 and Later (Annual)	Single Pay	36	(\$75,000)	(\$307,795)	0.17266	(\$53,143)
Sediment/Surface Water Sampling (Biennial)	Single Pay	36	(\$60,000)	(\$246,236)	0.17266	(\$42,514)
Institutional Controls, Check and Maintain	Single Pay	37	(\$1,500)	(\$6,402)	0.16444	(\$1,053)
LTGM, Year 11 and Later (Annual)	Single Pay	37	(\$75,000)	(\$320,107)	0.16444	(\$52,637)
Institutional Controls, Check and Maintain	Single Pay	38	(\$1,500)	(\$6,658)	0.15661	(\$1,043)
LTGM, Year 11 and Later (Annual)	Single Pay	38	(\$75,000)	(\$332,911)	0.15661	(\$52,136)
Sediment/Surface Water Sampling (Biennial)	Single Pay	38	(\$60,000)	(\$266,329)	0.15661	(\$41,709)
Institutional Controls, Check and Maintain	Single Pay	39	(\$1,500)	(\$6,925)	0.14915	(\$1,033)
LTGM, Year 11 and Later (Annual)	Single Pay	39	(\$75,000)	(\$346,227)	0.14915	(\$51,639)
Institutional Controls, Check and Maintain	Single Pay	40	(\$1,500)	(\$7,202)	0.14205	(\$1,023)
LTGM, Year 11 and Later (Annual)	Single Pay	40	(\$75,000)	(\$360,077)	0.14205	(\$51,147)
Sediment/Surface Water Sampling (Biennial)	Single Pay	40	(\$60,000)	(\$288,061)	0.14205	(\$40,918)
Periodic Expenditure Subtotal						(\$4,525,360)
TOTAL PRESENT WORTH COST						(\$4,550,240)



Solutia, TSR Cost Estimate

AOC:

MHU and DHU

Average or Most Probable Estimate (Without GMCS O&M)

Discount Rate = 5.0%

Inflation Rate = 4.0%

LTGM, Year 11 and Later (Annual)	Single Pay	13	(\$75,000)	(\$124,881)	0.53032	(\$66,227)
Institutional Controls, Check and Maintain	Single Pay	14	(\$1,500)	(\$2,598)	0.50507	(\$1,312)
LTGM, Year 11 and Later (Annual)	Single Pay	14	(\$75,000)	(\$129,876)	0.50507	(\$65,596)
Sediment/Surface Water Sampling (Biennial)	Single Pay	14	(\$60,000)	(\$103,901)	0.50507	(\$52,477)
Institutional Controls, Check and Maintain	Single Pay	15	(\$1,500)	(\$2,701)	0.48102	(\$1,299)
LTGM, Year 11 and Later (Annual)	Single Pay	15	(\$75,000)	(\$135,071)	0.48102	(\$64,971)
Institutional Controls, Check and Maintain	Single Pay	16	(\$1,500)	(\$2,809)	0.45811	(\$1,287)
LTGM, Year 11 and Later (Annual)	Single Pay	16	(\$75,000)	(\$140,474)	0.45811	(\$64,353)
Sediment/Surface Water Sampling (Biennial)	Single Pay	16	(\$60,000)	(\$112,379)	0.45811	(\$51,482)
Institutional Controls, Check and Maintain	Single Pay	17	(\$1,500)	(\$2,922)	0.43630	(\$1,275)
LTGM, Year 11 and Later (Annual)	Single Pay	17	(\$75,000)	(\$146,093)	0.43630	(\$63,740)
Institutional Controls, Check and Maintain	Single Pay	18	(\$1,500)	(\$3,039)	0.41552	(\$1,263)
LTGM, Year 11 and Later (Annual)	Single Pay	18	(\$75,000)	(\$151,936)	0.41552	(\$63,133)
Sediment/Surface Water Sampling (Biennial)	Single Pay	18	(\$60,000)	(\$121,549)	0.41552	(\$50,506)
Institutional Controls, Check and Maintain	Single Pay	19	(\$1,500)	(\$3,160)	0.39573	(\$1,251)
LTGM, Year 11 and Later (Annual)	Single Pay	19	(\$75,000)	(\$158,014)	0.39573	(\$62,531)
Institutional Controls, Check and Maintain	Single Pay	20	(\$1,500)	(\$3,287)	0.37689	(\$1,239)
LTGM, Year 11 and Later (Annual)	Single Pay	20	(\$75,000)	(\$164,334)	0.37689	(\$61,936)
Sediment/Surface Water Sampling (Biennial)	Single Pay	20	(\$60,000)	(\$131,467)	0.37689	(\$49,549)
Institutional Controls, Check and Maintain	Single Pay	21	(\$1,500)	(\$3,418)	0.35894	(\$1,227)
LTGM, Year 11 and Later (Annual)	Single Pay	21	(\$75,000)	(\$170,908)	0.35894	(\$61,346)
Institutional Controls, Check and Maintain	Single Pay	22	(\$1,500)	(\$3,555)	0.34185	(\$1,215)
LTGM, Year 11 and Later (Annual)	Single Pay	22	(\$75,000)	(\$177,744)	0.34185	(\$60,762)
Sediment/Surface Water Sampling (Biennial)	Single Pay	22	(\$60,000)	(\$142,195)	0.34185	(\$48,609)
Institutional Controls, Check and Maintain	Single Pay	23	(\$1,500)	(\$3,697)	0.32557	(\$1,204)
LTGM, Year 11 and Later (Annual)	Single Pay	23	(\$75,000)	(\$184,854)	0.32557	(\$60,183)
Institutional Controls, Check and Maintain	Single Pay	24	(\$1,500)	(\$3,845)	0.31007	(\$1,192)
LTGM, Year 11 and Later (Annual)	Single Pay	24	(\$75,000)	(\$192,248)	0.31007	(\$59,610)
Sediment/Surface Water Sampling (Biennial)	Single Pay	24	(\$60,000)	(\$153,798)	0.31007	(\$47,688)
Institutional Controls, Check and Maintain	Single Pay	25	(\$1,500)	(\$3,999)	0.29530	(\$1,181)
LTGM, Year 11 and Later (Annual)	Single Pay	25	(\$75,000)	(\$199,938)	0.29530	(\$59,042)
Institutional Controls, Check and Maintain	Single Pay	26	(\$1,500)	(\$4,159)	0.28124	(\$1,170)
LTGM, Year 11 and Later (Annual)	Single Pay	26	(\$75,000)	(\$207,935)	0.28124	(\$58,480)
Sediment/Surface Water Sampling (Biennial)	Single Pay	26	(\$60,000)	(\$166,348)	0.28124	(\$46,784)
Institutional Controls, Check and Maintain	Single Pay	27	(\$1,500)	(\$4,325)	0.26785	(\$1,158)
LTGM, Year 11 and Later (Annual)	Single Pay	27	(\$75,000)	(\$216,253)	0.26785	(\$57,923)
Institutional Controls, Check and Maintain	Single Pay	28	(\$1,500)	(\$4,498)	0.25509	(\$1,147)



Solutia, TSR Cost Estimate

AOC:

MHU and DHU

Average or Most Probable Estimate (Without GMCS O&M)

Discount Rate = 5.0%

Inflation Rate = 4.0%

	Type	Year or Years	Cost	Escalated Cost	P-W Factor	Present Worth
<b>Capital Expenditures:</b>						
Additional Wells, Install and Develop	Single Pay	0.5	(\$25,000)	(\$25,495)	0.97590	(\$24,881)
<b>Capital Expenditure Subtotal</b>						<b>(\$24,881)</b>
<b>Periodic Expenditures:</b>						
Institutional Controls, Check and Maintain	Single Pay	1	(\$1,500)	(\$1,560)	0.95238	(\$1,486)
LTGM, First Two Years (Quarterly)	Single Pay	1	(\$300,000)	(\$312,000)	0.95238	(\$297,143)
Institutional Controls, Check and Maintain	Single Pay	2	(\$1,500)	(\$1,622)	0.90703	(\$1,472)
LTGM, First Two Years (Quarterly)	Single Pay	2	(\$300,000)	(\$324,480)	0.90703	(\$294,313)
Sediment/Surface Water Sampling (Biennial)	Single Pay	2	(\$60,000)	(\$64,896)	0.90703	(\$58,863)
Institutional Controls, Check and Maintain	Single Pay	3	(\$1,500)	(\$1,687)	0.86384	(\$1,458)
LTGM, Years 3-10 (Semi-Annual)	Single Pay	3	(\$150,000)	(\$168,730)	0.86384	(\$145,755)
Institutional Controls, Check and Maintain	Single Pay	4	(\$1,500)	(\$1,755)	0.82270	(\$1,444)
LTGM, Years 3-10 (Semi-Annual)	Single Pay	4	(\$150,000)	(\$175,479)	0.82270	(\$144,367)
Sediment/Surface Water Sampling (Biennial)	Single Pay	4	(\$60,000)	(\$70,192)	0.82270	(\$57,747)
Institutional Controls, Check and Maintain	Single Pay	5	(\$1,500)	(\$1,825)	0.78353	(\$1,430)
LTGM, Years 3-10 (Semi-Annual)	Single Pay	5	(\$150,000)	(\$182,498)	0.78353	(\$142,992)
Institutional Controls, Check and Maintain	Single Pay	6	(\$1,500)	(\$1,898)	0.74622	(\$1,416)
LTGM, Years 3-10 (Semi-Annual)	Single Pay	6	(\$150,000)	(\$189,798)	0.74622	(\$141,630)
Sediment/Surface Water Sampling (Biennial)	Single Pay	6	(\$60,000)	(\$75,919)	0.74622	(\$56,652)
Institutional Controls, Check and Maintain	Single Pay	7	(\$1,500)	(\$1,974)	0.71068	(\$1,403)
LTGM, Years 3-10 (Semi-Annual)	Single Pay	7	(\$150,000)	(\$197,390)	0.71068	(\$140,281)
Institutional Controls, Check and Maintain	Single Pay	8	(\$1,500)	(\$2,053)	0.67684	(\$1,389)
LTGM, Years 3-10 (Semi-Annual)	Single Pay	8	(\$150,000)	(\$205,285)	0.67684	(\$138,945)
Sediment/Surface Water Sampling (Biennial)	Single Pay	8	(\$60,000)	(\$82,114)	0.67684	(\$55,578)
Institutional Controls, Check and Maintain	Single Pay	9	(\$1,500)	(\$2,135)	0.64461	(\$1,376)
LTGM, Years 3-10 (Semi-Annual)	Single Pay	9	(\$150,000)	(\$213,497)	0.64461	(\$137,622)
Institutional Controls, Check and Maintain	Single Pay	10	(\$1,500)	(\$2,220)	0.61391	(\$1,363)
LTGM, Years 3-10 (Semi-Annual)	Single Pay	10	(\$150,000)	(\$222,037)	0.61391	(\$136,311)
Sediment/Surface Water Sampling (Biennial)	Single Pay	10	(\$60,000)	(\$88,815)	0.61391	(\$54,524)
Institutional Controls, Check and Maintain	Single Pay	11	(\$1,500)	(\$2,309)	0.58468	(\$1,350)
LTGM, Year 11 and Later (Annual)	Single Pay	11	(\$75,000)	(\$115,459)	0.58468	(\$67,507)
Institutional Controls, Check and Maintain	Single Pay	12	(\$1,500)	(\$2,402)	0.55684	(\$1,337)
LTGM, Year 11 and Later (Annual)	Single Pay	12	(\$75,000)	(\$120,077)	0.55684	(\$66,864)
Sediment/Surface Water Sampling (Biennial)	Single Pay	12	(\$60,000)	(\$96,062)	0.55684	(\$53,491)
Institutional Controls, Check and Maintain	Single Pay	13	(\$1,500)	(\$2,498)	0.53032	(\$1,325)

Solutia, TSR Cost Estimate

AOC:

MHU and DHU

Maximum or Most Conservative Estimate (Including GMCS O&M)

Discount Rate = 5.0%

Inflation Rate = 4.0%

GMCS O&M	Single Pay	52	(\$1,675,000)	(\$12,875,036)	0.07910	(\$1,018,368)
Institutional Controls, Check and Maintain	Single Pay	52	(\$1,500)	(\$11,530)	0.07910	(\$912)
LTGM, Year 11 and Later (Annual)	Single Pay	52	(\$105,000)	(\$807,092)	0.07910	(\$63,838)
Sediment/Surface Water Sampling (Biennial)	Single Pay	52	(\$100,000)	(\$768,659)	0.07910	(\$60,798)
GMCS O&M	Single Pay	53	(\$1,675,000)	(\$13,390,038)	0.07533	(\$1,008,670)
Institutional Controls, Check and Maintain	Single Pay	53	(\$1,500)	(\$11,991)	0.07533	(\$903)
LTGM, Year 11 and Later (Annual)	Single Pay	53	(\$105,000)	(\$839,375)	0.07533	(\$63,230)
GMCS O&M	Single Pay	54	(\$1,675,000)	(\$13,925,639)	0.07174	(\$999,063)
Institutional Controls, Check and Maintain	Single Pay	54	(\$1,500)	(\$12,471)	0.07174	(\$895)
LTGM, Year 11 and Later (Annual)	Single Pay	54	(\$105,000)	(\$872,951)	0.07174	(\$62,628)
Sediment/Surface Water Sampling (Biennial)	Single Pay	54	(\$100,000)	(\$831,381)	0.07174	(\$59,646)
GMCS O&M	Single Pay	55	(\$1,675,000)	(\$14,482,665)	0.06833	(\$989,548)
Institutional Controls, Check and Maintain	Single Pay	55	(\$1,500)	(\$12,970)	0.06833	(\$886)
LTGM, Year 11 and Later (Annual)	Single Pay	55	(\$105,000)	(\$907,869)	0.06833	(\$62,031)
GMCS O&M	Single Pay	56	(\$1,675,000)	(\$15,061,971)	0.06507	(\$980,124)
Institutional Controls, Check and Maintain	Single Pay	56	(\$1,500)	(\$13,488)	0.06507	(\$878)
LTGM, Year 11 and Later (Annual)	Single Pay	56	(\$105,000)	(\$944,183)	0.06507	(\$61,441)
Sediment/Surface Water Sampling (Biennial)	Single Pay	56	(\$100,000)	(\$899,222)	0.06507	(\$58,515)
GMCS O&M	Single Pay	57	(\$1,675,000)	(\$15,664,450)	0.06197	(\$970,790)
Institutional Controls, Check and Maintain	Single Pay	57	(\$1,500)	(\$14,028)	0.06197	(\$869)
LTGM, Year 11 and Later (Annual)	Single Pay	57	(\$105,000)	(\$981,951)	0.06197	(\$60,855)
GMCS O&M	Single Pay	58	(\$1,675,000)	(\$16,291,028)	0.05902	(\$961,544)
Institutional Controls, Check and Maintain	Single Pay	58	(\$1,500)	(\$14,589)	0.05902	(\$861)
LTGM, Year 11 and Later (Annual)	Single Pay	58	(\$105,000)	(\$1,021,229)	0.05902	(\$60,276)
Sediment/Surface Water Sampling (Biennial)	Single Pay	58	(\$100,000)	(\$972,599)	0.05902	(\$57,406)
GMCS O&M	Single Pay	59	(\$1,675,000)	(\$16,942,669)	0.05621	(\$952,386)
Institutional Controls, Check and Maintain	Single Pay	59	(\$1,500)	(\$15,173)	0.05621	(\$853)
LTGM, Year 11 and Later (Annual)	Single Pay	59	(\$105,000)	(\$1,062,078)	0.05621	(\$59,702)
GMCS O&M	Single Pay	60	(\$1,675,000)	(\$17,620,376)	0.05354	(\$943,316)
Institutional Controls, Check and Maintain	Single Pay	60	(\$1,500)	(\$15,779)	0.05354	(\$845)
LTGM, Year 11 and Later (Annual)	Single Pay	60	(\$105,000)	(\$1,104,561)	0.05354	(\$59,133)
Sediment/Surface Water Sampling (Biennial)	Single Pay	60	(\$100,000)	(\$1,051,963)	0.05354	(\$56,317)
Periodic Expenditure Subtotal						(\$84,604,607)
TOTAL PRESENT WORTH COST						(\$84,716,570)



Solutia, TSR Cost Estimate

AOC:

MHU and DHU

Maximum or Most Conservative Estimate (Including GMCS O&M)

Discount Rate = 5.0%

Inflation Rate = 4.0%

Institutional Controls, Check and Maintain	Single Pay	41	(\$1,500)	(\$7,490)	0.13528	(\$1,013)
LTGM, Year 11 and Later (Annual)	Single Pay	41	(\$105,000)	(\$524,271)	0.13528	(\$70,924)
GMCS O&M	Single Pay	42	(\$1,675,000)	(\$8,697,913)	0.12884	(\$1,120,636)
Institutional Controls, Check and Maintain	Single Pay	42	(\$1,500)	(\$7,789)	0.12884	(\$1,004)
LTGM, Year 11 and Later (Annual)	Single Pay	42	(\$105,000)	(\$545,242)	0.12884	(\$70,249)
Sediment/Surface Water Sampling (Biennial)	Single Pay	42	(\$100,000)	(\$519,278)	0.12884	(\$66,904)
GMCS O&M	Single Pay	43	(\$1,675,000)	(\$9,045,830)	0.12270	(\$1,109,963)
Institutional Controls, Check and Maintain	Single Pay	43	(\$1,500)	(\$8,101)	0.12270	(\$994)
LTGM, Year 11 and Later (Annual)	Single Pay	43	(\$105,000)	(\$567,052)	0.12270	(\$69,580)
GMCS O&M	Single Pay	44	(\$1,675,000)	(\$9,407,663)	0.11686	(\$1,099,392)
Institutional Controls, Check and Maintain	Single Pay	44	(\$1,500)	(\$8,425)	0.11686	(\$985)
LTGM, Year 11 and Later (Annual)	Single Pay	44	(\$105,000)	(\$589,734)	0.11686	(\$68,917)
Sediment/Surface Water Sampling (Biennial)	Single Pay	44	(\$100,000)	(\$561,652)	0.11686	(\$65,635)
GMCS O&M	Single Pay	45	(\$1,675,000)	(\$9,783,969)	0.11130	(\$1,088,922)
Institutional Controls, Check and Maintain	Single Pay	45	(\$1,500)	(\$8,762)	0.11130	(\$975)
LTGM, Year 11 and Later (Annual)	Single Pay	45	(\$105,000)	(\$613,323)	0.11130	(\$68,261)
GMCS O&M	Single Pay	46	(\$1,675,000)	(\$10,175,328)	0.10600	(\$1,078,551)
Institutional Controls, Check and Maintain	Single Pay	46	(\$1,500)	(\$9,112)	0.10600	(\$966)
LTGM, Year 11 and Later (Annual)	Single Pay	46	(\$105,000)	(\$637,856)	0.10600	(\$67,611)
Sediment/Surface Water Sampling (Biennial)	Single Pay	46	(\$100,000)	(\$607,482)	0.10600	(\$64,391)
GMCS O&M	Single Pay	47	(\$1,675,000)	(\$10,582,341)	0.10095	(\$1,068,279)
Institutional Controls, Check and Maintain	Single Pay	47	(\$1,500)	(\$9,477)	0.10095	(\$957)
LTGM, Year 11 and Later (Annual)	Single Pay	47	(\$105,000)	(\$663,371)	0.10095	(\$66,967)
GMCS O&M	Single Pay	48	(\$1,675,000)	(\$11,005,635)	0.09614	(\$1,058,105)
Institutional Controls, Check and Maintain	Single Pay	48	(\$1,500)	(\$9,856)	0.09614	(\$948)
LTGM, Year 11 and Later (Annual)	Single Pay	48	(\$105,000)	(\$689,905)	0.09614	(\$66,329)
Sediment/Surface Water Sampling (Biennial)	Single Pay	48	(\$100,000)	(\$657,053)	0.09614	(\$63,170)
GMCS O&M	Single Pay	49	(\$1,675,000)	(\$11,445,860)	0.09156	(\$1,048,028)
Institutional Controls, Check and Maintain	Single Pay	49	(\$1,500)	(\$10,250)	0.09156	(\$939)
LTGM, Year 11 and Later (Annual)	Single Pay	49	(\$105,000)	(\$717,502)	0.09156	(\$65,697)
GMCS O&M	Single Pay	50	(\$1,675,000)	(\$11,903,695)	0.08720	(\$1,038,047)
Institutional Controls, Check and Maintain	Single Pay	50	(\$1,500)	(\$10,660)	0.08720	(\$930)
LTGM, Year 11 and Later (Annual)	Single Pay	50	(\$105,000)	(\$746,202)	0.08720	(\$65,072)
Sediment/Surface Water Sampling (Biennial)	Single Pay	50	(\$100,000)	(\$710,668)	0.08720	(\$61,973)
GMCS O&M	Single Pay	51	(\$1,675,000)	(\$12,379,842)	0.08305	(\$1,028,160)
Institutional Controls, Check and Maintain	Single Pay	51	(\$1,500)	(\$11,086)	0.08305	(\$921)
LTGM, Year 11 and Later (Annual)	Single Pay	51	(\$105,000)	(\$776,050)	0.08305	(\$64,452)



**Solutia, TSR Cost Estimate**

AOC:

MHU and DHU

**Maximum or Most Conservative Estimate (Including GMCS O&M)**

Discount Rate = 5.0%

Inflation Rate = 4.0%

Sediment/Surface Water Sampling (Biennial)	Single Pay	30	(\$100,000)	(\$324,340)	0.23138	(\$75,045)
GMCS O&M	Single Pay	31	(\$1,675,000)	(\$5,649,998)	0.22036	(\$1,245,031)
Institutional Controls, Check and Maintain	Single Pay	31	(\$1,500)	(\$5,060)	0.22036	(\$1,115)
LTGM, Year 11 and Later (Annual)	Single Pay	31	(\$105,000)	(\$354,179)	0.22036	(\$78,047)
GMCS O&M	Single Pay	32	(\$1,675,000)	(\$5,875,998)	0.20987	(\$1,233,173)
Institutional Controls, Check and Maintain	Single Pay	32	(\$1,500)	(\$5,262)	0.20987	(\$1,104)
LTGM, Year 11 and Later (Annual)	Single Pay	32	(\$105,000)	(\$368,346)	0.20987	(\$77,303)
Sediment/Surface Water Sampling (Biennial)	Single Pay	32	(\$100,000)	(\$350,806)	0.20987	(\$73,622)
GMCS O&M	Single Pay	33	(\$1,675,000)	(\$6,111,038)	0.19987	(\$1,221,429)
Institutional Controls, Check and Maintain	Single Pay	33	(\$1,500)	(\$5,473)	0.19987	(\$1,094)
LTGM, Year 11 and Later (Annual)	Single Pay	33	(\$105,000)	(\$383,080)	0.19987	(\$76,567)
GMCS O&M	Single Pay	34	(\$1,675,000)	(\$6,355,480)	0.19035	(\$1,209,796)
Institutional Controls, Check and Maintain	Single Pay	34	(\$1,500)	(\$5,691)	0.19035	(\$1,083)
LTGM, Year 11 and Later (Annual)	Single Pay	34	(\$105,000)	(\$398,403)	0.19035	(\$75,838)
Sediment/Surface Water Sampling (Biennial)	Single Pay	34	(\$100,000)	(\$379,432)	0.19035	(\$72,227)
GMCS O&M	Single Pay	35	(\$1,675,000)	(\$6,609,699)	0.18129	(\$1,198,274)
Institutional Controls, Check and Maintain	Single Pay	35	(\$1,500)	(\$5,919)	0.18129	(\$1,073)
LTGM, Year 11 and Later (Annual)	Single Pay	35	(\$105,000)	(\$414,339)	0.18129	(\$75,116)
GMCS O&M	Single Pay	36	(\$1,675,000)	(\$6,874,087)	0.17266	(\$1,186,862)
Institutional Controls, Check and Maintain	Single Pay	36	(\$1,500)	(\$6,156)	0.17266	(\$1,063)
LTGM, Year 11 and Later (Annual)	Single Pay	36	(\$105,000)	(\$430,913)	0.17266	(\$74,400)
Sediment/Surface Water Sampling (Biennial)	Single Pay	36	(\$100,000)	(\$410,393)	0.17266	(\$70,857)
GMCS O&M	Single Pay	37	(\$1,675,000)	(\$7,149,051)	0.16444	(\$1,175,559)
Institutional Controls, Check and Maintain	Single Pay	37	(\$1,500)	(\$6,402)	0.16444	(\$1,053)
LTGM, Year 11 and Later (Annual)	Single Pay	37	(\$105,000)	(\$448,149)	0.16444	(\$73,692)
GMCS O&M	Single Pay	38	(\$1,675,000)	(\$7,435,013)	0.15661	(\$1,164,363)
Institutional Controls, Check and Maintain	Single Pay	38	(\$1,500)	(\$6,658)	0.15661	(\$1,043)
LTGM, Year 11 and Later (Annual)	Single Pay	38	(\$105,000)	(\$466,075)	0.15661	(\$72,990)
Sediment/Surface Water Sampling (Biennial)	Single Pay	38	(\$100,000)	(\$443,881)	0.15661	(\$69,514)
GMCS O&M	Single Pay	39	(\$1,675,000)	(\$7,732,413)	0.14915	(\$1,153,274)
Institutional Controls, Check and Maintain	Single Pay	39	(\$1,500)	(\$6,925)	0.14915	(\$1,033)
LTGM, Year 11 and Later (Annual)	Single Pay	39	(\$105,000)	(\$484,718)	0.14915	(\$72,295)
GMCS O&M	Single Pay	40	(\$1,675,000)	(\$8,041,710)	0.14205	(\$1,142,290)
Institutional Controls, Check and Maintain	Single Pay	40	(\$1,500)	(\$7,202)	0.14205	(\$1,023)
LTGM, Year 11 and Later (Annual)	Single Pay	40	(\$105,000)	(\$504,107)	0.14205	(\$71,606)
Sediment/Surface Water Sampling (Biennial)	Single Pay	40	(\$100,000)	(\$480,102)	0.14205	(\$68,196)
GMCS O&M	Single Pay	41	(\$1,675,000)	(\$8,363,378)	0.13528	(\$1,131,411)

Solutia, TSR Cost Estimate

AOC:

MHU and DHU

Maximum or Most Conservative Estimate (Including GMCS O&M)

Discount Rate = 5.0%

Inflation Rate = 4.0%

Institutional Controls, Check and Maintain	Single Pay	20	(\$1,500)	(\$3,287)	0.37689	(\$1,239)
LTGM, Year 11 and Later (Annual)	Single Pay	20	(\$105,000)	(\$230,068)	0.37689	(\$86,710)
Sediment/Surface Water Sampling (Biennial)	Single Pay	20	(\$100,000)	(\$219,112)	0.37689	(\$82,581)
GMCS O&M	Single Pay	21	(\$1,675,000)	(\$3,816,937)	0.35894	(\$1,370,060)
Institutional Controls, Check and Maintain	Single Pay	21	(\$1,500)	(\$3,418)	0.35894	(\$1,227)
LTGM, Year 11 and Later (Annual)	Single Pay	21	(\$105,000)	(\$239,271)	0.35894	(\$85,884)
GMCS O&M	Single Pay	22	(\$1,675,000)	(\$3,969,614)	0.34185	(\$1,357,012)
Institutional Controls, Check and Maintain	Single Pay	22	(\$1,500)	(\$3,555)	0.34185	(\$1,215)
LTGM, Year 11 and Later (Annual)	Single Pay	22	(\$105,000)	(\$248,841)	0.34185	(\$85,066)
Sediment/Surface Water Sampling (Biennial)	Single Pay	22	(\$100,000)	(\$236,992)	0.34185	(\$81,016)
GMCS O&M	Single Pay	23	(\$1,675,000)	(\$4,128,399)	0.32557	(\$1,344,088)
Institutional Controls, Check and Maintain	Single Pay	23	(\$1,500)	(\$3,697)	0.32557	(\$1,204)
LTGM, Year 11 and Later (Annual)	Single Pay	23	(\$105,000)	(\$258,795)	0.32557	(\$84,256)
GMCS O&M	Single Pay	24	(\$1,675,000)	(\$4,293,534)	0.31007	(\$1,331,287)
Institutional Controls, Check and Maintain	Single Pay	24	(\$1,500)	(\$3,845)	0.31007	(\$1,192)
LTGM, Year 11 and Later (Annual)	Single Pay	24	(\$105,000)	(\$269,147)	0.31007	(\$83,454)
Sediment/Surface Water Sampling (Biennial)	Single Pay	24	(\$100,000)	(\$256,330)	0.31007	(\$79,480)
GMCS O&M	Single Pay	25	(\$1,675,000)	(\$4,465,276)	0.29530	(\$1,318,608)
Institutional Controls, Check and Maintain	Single Pay	25	(\$1,500)	(\$3,999)	0.29530	(\$1,181)
LTGM, Year 11 and Later (Annual)	Single Pay	25	(\$105,000)	(\$279,913)	0.29530	(\$82,659)
GMCS O&M	Single Pay	26	(\$1,675,000)	(\$4,643,887)	0.28124	(\$1,306,050)
Institutional Controls, Check and Maintain	Single Pay	26	(\$1,500)	(\$4,159)	0.28124	(\$1,170)
LTGM, Year 11 and Later (Annual)	Single Pay	26	(\$105,000)	(\$291,109)	0.28124	(\$81,872)
Sediment/Surface Water Sampling (Biennial)	Single Pay	26	(\$100,000)	(\$277,247)	0.28124	(\$77,973)
GMCS O&M	Single Pay	27	(\$1,675,000)	(\$4,829,642)	0.26785	(\$1,293,612)
Institutional Controls, Check and Maintain	Single Pay	27	(\$1,500)	(\$4,325)	0.26785	(\$1,158)
LTGM, Year 11 and Later (Annual)	Single Pay	27	(\$105,000)	(\$302,754)	0.26785	(\$81,092)
GMCS O&M	Single Pay	28	(\$1,675,000)	(\$5,022,828)	0.25509	(\$1,281,291)
Institutional Controls, Check and Maintain	Single Pay	28	(\$1,500)	(\$4,498)	0.25509	(\$1,147)
LTGM, Year 11 and Later (Annual)	Single Pay	28	(\$105,000)	(\$314,864)	0.25509	(\$80,320)
Sediment/Surface Water Sampling (Biennial)	Single Pay	28	(\$100,000)	(\$299,870)	0.25509	(\$76,495)
GMCS O&M	Single Pay	29	(\$1,675,000)	(\$5,223,741)	0.24295	(\$1,269,089)
Institutional Controls, Check and Maintain	Single Pay	29	(\$1,500)	(\$4,678)	0.24295	(\$1,136)
LTGM, Year 11 and Later (Annual)	Single Pay	29	(\$105,000)	(\$327,458)	0.24295	(\$79,555)
GMCS O&M	Single Pay	30	(\$1,675,000)	(\$5,432,691)	0.23138	(\$1,257,002)
Institutional Controls, Check and Maintain	Single Pay	30	(\$1,500)	(\$4,865)	0.23138	(\$1,126)
LTGM, Year 11 and Later (Annual)	Single Pay	30	(\$105,000)	(\$340,557)	0.23138	(\$78,797)



Solutia, TSR Cost Estimate

AOC:

MHU and DHU

Maximum or Most Conservative Estimate (Including GMCS O&M)

Discount Rate = 5.0%

Inflation Rate = 4.0%

LTGM, Years 3-10 (Semi-Annual)	Single Pay	9	(\$210,000)	(\$298,895)	0.64461	(\$192,671)
GMCS O&M	Single Pay	10	(\$1,675,000)	(\$2,479,409)	0.61391	(\$1,522,142)
Institutional Controls, Check and Maintain	Single Pay	10	(\$1,500)	(\$2,220)	0.61391	(\$1,363)
LTGM, Years 3-10 (Semi-Annual)	Single Pay	10	(\$210,000)	(\$310,851)	0.61391	(\$190,836)
Sediment/Surface Water Sampling (Biennial)	Single Pay	10	(\$100,000)	(\$148,024)	0.61391	(\$90,874)
GMCS O&M	Single Pay	11	(\$1,675,000)	(\$2,578,586)	0.58468	(\$1,507,646)
Institutional Controls, Check and Maintain	Single Pay	11	(\$1,500)	(\$2,309)	0.58468	(\$1,350)
LTGM, Year 11 and Later (Annual)	Single Pay	11	(\$105,000)	(\$161,643)	0.58468	(\$94,509)
GMCS O&M	Single Pay	12	(\$1,675,000)	(\$2,681,729)	0.55684	(\$1,493,287)
Institutional Controls, Check and Maintain	Single Pay	12	(\$1,500)	(\$2,402)	0.55684	(\$1,337)
LTGM, Year 11 and Later (Annual)	Single Pay	12	(\$105,000)	(\$168,108)	0.55684	(\$93,609)
Sediment/Surface Water Sampling (Biennial)	Single Pay	12	(\$100,000)	(\$160,103)	0.55684	(\$89,151)
GMCS O&M	Single Pay	13	(\$1,675,000)	(\$2,788,998)	0.53032	(\$1,479,065)
Institutional Controls, Check and Maintain	Single Pay	13	(\$1,500)	(\$2,498)	0.53032	(\$1,325)
LTGM, Year 11 and Later (Annual)	Single Pay	13	(\$105,000)	(\$174,833)	0.53032	(\$92,718)
GMCS O&M	Single Pay	14	(\$1,675,000)	(\$2,900,558)	0.50507	(\$1,464,979)
Institutional Controls, Check and Maintain	Single Pay	14	(\$1,500)	(\$2,598)	0.50507	(\$1,312)
LTGM, Year 11 and Later (Annual)	Single Pay	14	(\$105,000)	(\$181,826)	0.50507	(\$91,834)
Sediment/Surface Water Sampling (Biennial)	Single Pay	14	(\$100,000)	(\$173,168)	0.50507	(\$87,461)
GMCS O&M	Single Pay	15	(\$1,675,000)	(\$3,016,580)	0.48102	(\$1,451,027)
Institutional Controls, Check and Maintain	Single Pay	15	(\$1,500)	(\$2,701)	0.48102	(\$1,299)
LTGM, Year 11 and Later (Annual)	Single Pay	15	(\$105,000)	(\$189,099)	0.48102	(\$90,960)
GMCS O&M	Single Pay	16	(\$1,675,000)	(\$3,137,244)	0.45811	(\$1,437,207)
Institutional Controls, Check and Maintain	Single Pay	16	(\$1,500)	(\$2,809)	0.45811	(\$1,287)
LTGM, Year 11 and Later (Annual)	Single Pay	16	(\$105,000)	(\$196,663)	0.45811	(\$90,094)
Sediment/Surface Water Sampling (Biennial)	Single Pay	16	(\$100,000)	(\$187,298)	0.45811	(\$85,803)
GMCS O&M	Single Pay	17	(\$1,675,000)	(\$3,262,733)	0.43630	(\$1,423,520)
Institutional Controls, Check and Maintain	Single Pay	17	(\$1,500)	(\$2,922)	0.43630	(\$1,275)
LTGM, Year 11 and Later (Annual)	Single Pay	17	(\$105,000)	(\$204,530)	0.43630	(\$89,236)
GMCS O&M	Single Pay	18	(\$1,675,000)	(\$3,393,243)	0.41552	(\$1,409,962)
Institutional Controls, Check and Maintain	Single Pay	18	(\$1,500)	(\$3,039)	0.41552	(\$1,263)
LTGM, Year 11 and Later (Annual)	Single Pay	18	(\$105,000)	(\$212,711)	0.41552	(\$88,386)
Sediment/Surface Water Sampling (Biennial)	Single Pay	18	(\$100,000)	(\$202,582)	0.41552	(\$84,177)
GMCS O&M	Single Pay	19	(\$1,675,000)	(\$3,528,972)	0.39573	(\$1,396,534)
Institutional Controls, Check and Maintain	Single Pay	19	(\$1,500)	(\$3,160)	0.39573	(\$1,251)
LTGM, Year 11 and Later (Annual)	Single Pay	19	(\$105,000)	(\$221,219)	0.39573	(\$87,544)
GMCS O&M	Single Pay	20	(\$1,675,000)	(\$3,670,131)	0.37689	(\$1,383,234)



Solutia, TSR Cost Estimate

AOC:

MHU and DHU

**Maximum or Most Conservative Estimate (Including GMCS O&M)**

Discount Rate = 5.0%

Inflation Rate = 4.0%

	Type	Year or Years	Cost	Escalated Cost	P-W Factor	Present Worth
<b>Capital Expenditures:</b>						
Additional Wells, Install and Develop	Single Pay	0.5	(\$112,500)	(\$114,728)	0.97590	(\$111,963)
<b>Capital Expenditure Subtotal</b>						<b>(\$111,963)</b>
<b>Periodic Expenditures:</b>						
GMCS O&M	Single Pay	1	(\$1,675,000)	(\$1,742,000)	0.95238	(\$1,659,048)
Institutional Controls, Check and Maintain	Single Pay	1	(\$1,500)	(\$1,560)	0.95238	(\$1,486)
LTGM, Year 11 and Later (Annual)	Single Pay	1	(\$420,000)	(\$436,800)	0.95238	(\$416,000)
GMCS O&M	Single Pay	2	(\$1,675,000)	(\$1,811,680)	0.90703	(\$1,643,247)
Institutional Controls, Check and Maintain	Single Pay	2	(\$1,500)	(\$1,622)	0.90703	(\$1,472)
LTGM, Year 11 and Later (Annual)	Single Pay	2	(\$420,000)	(\$454,272)	0.90703	(\$412,038)
Sediment/Surface Water Sampling (Biennial)	Single Pay	2	(\$100,000)	(\$108,160)	0.90703	(\$98,104)
GMCS O&M	Single Pay	3	(\$1,675,000)	(\$1,884,147)	0.86384	(\$1,627,597)
Institutional Controls, Check and Maintain	Single Pay	3	(\$1,500)	(\$1,687)	0.86384	(\$1,458)
LTGM, Years 3-10 (Semi-Annual)	Single Pay	3	(\$210,000)	(\$236,221)	0.86384	(\$204,057)
GMCS O&M	Single Pay	4	(\$1,675,000)	(\$1,959,513)	0.82270	(\$1,612,096)
Institutional Controls, Check and Maintain	Single Pay	4	(\$1,500)	(\$1,755)	0.82270	(\$1,444)
LTGM, Years 3-10 (Semi-Annual)	Single Pay	4	(\$210,000)	(\$245,670)	0.82270	(\$202,114)
Sediment/Surface Water Sampling (Biennial)	Single Pay	4	(\$100,000)	(\$116,986)	0.82270	(\$96,245)
GMCS O&M	Single Pay	5	(\$1,675,000)	(\$2,037,894)	0.78353	(\$1,596,743)
Institutional Controls, Check and Maintain	Single Pay	5	(\$1,500)	(\$1,825)	0.78353	(\$1,430)
LTGM, Years 3-10 (Semi-Annual)	Single Pay	5	(\$210,000)	(\$255,497)	0.78353	(\$200,189)
GMCS O&M	Single Pay	6	(\$1,675,000)	(\$2,119,409)	0.74622	(\$1,581,536)
Institutional Controls, Check and Maintain	Single Pay	6	(\$1,500)	(\$1,898)	0.74622	(\$1,416)
LTGM, Years 3-10 (Semi-Annual)	Single Pay	6	(\$210,000)	(\$265,717)	0.74622	(\$198,282)
Sediment/Surface Water Sampling (Biennial)	Single Pay	6	(\$100,000)	(\$126,532)	0.74622	(\$94,420)
GMCS O&M	Single Pay	7	(\$1,675,000)	(\$2,204,186)	0.71068	(\$1,566,474)
Institutional Controls, Check and Maintain	Single Pay	7	(\$1,500)	(\$1,974)	0.71068	(\$1,403)
LTGM, Years 3-10 (Semi-Annual)	Single Pay	7	(\$210,000)	(\$276,346)	0.71068	(\$196,394)
GMCS O&M	Single Pay	8	(\$1,675,000)	(\$2,292,353)	0.67684	(\$1,551,555)
Institutional Controls, Check and Maintain	Single Pay	8	(\$1,500)	(\$2,053)	0.67684	(\$1,389)
LTGM, Years 3-10 (Semi-Annual)	Single Pay	8	(\$210,000)	(\$287,400)	0.67684	(\$194,523)
Sediment/Surface Water Sampling (Biennial)	Single Pay	8	(\$100,000)	(\$136,857)	0.67684	(\$92,630)
GMCS O&M	Single Pay	9	(\$1,675,000)	(\$2,384,047)	0.64461	(\$1,536,778)
Institutional Controls, Check and Maintain	Single Pay	9	(\$1,500)	(\$2,135)	0.64461	(\$1,376)

**Solutia, TSR Cost Estimate**

AOC:

MHU and DHU

**Average or Most Probable Estimate (Including GMCS O&M)**

Discount Rate = 5.0%

Inflation Rate = 4.0%

Institutional Controls, Check and Maintain	Single Pay	31	(\$1,500)	(\$5,060)	0.22036	(\$1,115)
LTGM, Year 11 and Later (Annual)	Single Pay	31	(\$75,000)	(\$252,985)	0.22036	(\$55,748)
GMCS O&M	Single Pay	32	(\$1,675,000)	(\$5,875,998)	0.20987	(\$1,233,173)
Institutional Controls, Check and Maintain	Single Pay	32	(\$1,500)	(\$5,262)	0.20987	(\$1,104)
LTGM, Year 11 and Later (Annual)	Single Pay	32	(\$75,000)	(\$263,104)	0.20987	(\$55,217)
Sediment/Surface Water Sampling (Biennial)	Single Pay	32	(\$60,000)	(\$210,484)	0.20987	(\$44,173)
GMCS O&M	Single Pay	33	(\$1,675,000)	(\$6,111,038)	0.19987	(\$1,221,429)
Institutional Controls, Check and Maintain	Single Pay	33	(\$1,500)	(\$5,473)	0.19987	(\$1,094)
LTGM, Year 11 and Later (Annual)	Single Pay	33	(\$75,000)	(\$273,629)	0.19987	(\$54,691)
GMCS O&M	Single Pay	34	(\$1,675,000)	(\$6,355,480)	0.19035	(\$1,209,796)
Institutional Controls, Check and Maintain	Single Pay	34	(\$1,500)	(\$5,691)	0.19035	(\$1,083)
LTGM, Year 11 and Later (Annual)	Single Pay	34	(\$75,000)	(\$284,574)	0.19035	(\$54,170)
Sediment/Surface Water Sampling (Biennial)	Single Pay	34	(\$60,000)	(\$227,659)	0.19035	(\$43,336)
GMCS O&M	Single Pay	35	(\$1,675,000)	(\$6,609,699)	0.18129	(\$1,198,274)
Institutional Controls, Check and Maintain	Single Pay	35	(\$1,500)	(\$5,919)	0.18129	(\$1,073)
LTGM, Year 11 and Later (Annual)	Single Pay	35	(\$75,000)	(\$295,957)	0.18129	(\$53,654)
GMCS O&M	Single Pay	36	(\$1,675,000)	(\$6,874,087)	0.17266	(\$1,186,862)
Institutional Controls, Check and Maintain	Single Pay	36	(\$1,500)	(\$6,156)	0.17266	(\$1,063)
LTGM, Year 11 and Later (Annual)	Single Pay	36	(\$75,000)	(\$307,795)	0.17266	(\$53,143)
Sediment/Surface Water Sampling (Biennial)	Single Pay	36	(\$60,000)	(\$246,236)	0.17266	(\$42,514)
GMCS O&M	Single Pay	37	(\$1,675,000)	(\$7,149,051)	0.16444	(\$1,175,559)
Institutional Controls, Check and Maintain	Single Pay	37	(\$1,500)	(\$6,402)	0.16444	(\$1,053)
LTGM, Year 11 and Later (Annual)	Single Pay	37	(\$75,000)	(\$320,107)	0.16444	(\$52,637)
GMCS O&M	Single Pay	38	(\$1,675,000)	(\$7,435,013)	0.15661	(\$1,164,363)
Institutional Controls, Check and Maintain	Single Pay	38	(\$1,500)	(\$6,658)	0.15661	(\$1,043)
LTGM, Year 11 and Later (Annual)	Single Pay	38	(\$75,000)	(\$332,911)	0.15661	(\$52,136)
Sediment/Surface Water Sampling (Biennial)	Single Pay	38	(\$60,000)	(\$266,329)	0.15661	(\$41,709)
GMCS O&M	Single Pay	39	(\$1,675,000)	(\$7,732,413)	0.14915	(\$1,153,274)
Institutional Controls, Check and Maintain	Single Pay	39	(\$1,500)	(\$6,925)	0.14915	(\$1,033)
LTGM, Year 11 and Later (Annual)	Single Pay	39	(\$75,000)	(\$346,227)	0.14915	(\$51,639)
GMCS O&M	Single Pay	40	(\$1,675,000)	(\$8,041,710)	0.14205	(\$1,142,290)
Institutional Controls, Check and Maintain	Single Pay	40	(\$1,500)	(\$7,202)	0.14205	(\$1,023)
LTGM, Year 11 and Later (Annual)	Single Pay	40	(\$75,000)	(\$360,077)	0.14205	(\$51,147)
Sediment/Surface Water Sampling (Biennial)	Single Pay	40	(\$60,000)	(\$288,061)	0.14205	(\$40,918)
Periodic Expenditure Subtotal						(\$59,927,187)
TOTAL PRESENT WORTH COST						(\$59,952,068)



Solutia, TSR Cost Estimate

AOC:

MHU and DHU

Average or Most Probable Estimate (Including GMCS O&M)

Discount Rate = 5.0%

Inflation Rate = 4.0%

LTGM, Year 11 and Later (Annual)	Single Pay	20	(\$75,000)	(\$164,334)	0.37689	(\$61,936)
Sediment/Surface Water Sampling (Biennial)	Single Pay	20	(\$60,000)	(\$131,467)	0.37689	(\$49,549)
GMCS O&M	Single Pay	21	(\$1,675,000)	(\$3,816,937)	0.35894	(\$1,370,060)
Institutional Controls, Check and Maintain	Single Pay	21	(\$1,500)	(\$3,418)	0.35894	(\$1,227)
LTGM, Year 11 and Later (Annual)	Single Pay	21	(\$75,000)	(\$170,908)	0.35894	(\$61,346)
GMCS O&M	Single Pay	22	(\$1,675,000)	(\$3,969,614)	0.34185	(\$1,357,012)
Institutional Controls, Check and Maintain	Single Pay	22	(\$1,500)	(\$3,555)	0.34185	(\$1,215)
LTGM, Year 11 and Later (Annual)	Single Pay	22	(\$75,000)	(\$177,744)	0.34185	(\$60,762)
Sediment/Surface Water Sampling (Biennial)	Single Pay	22	(\$60,000)	(\$142,195)	0.34185	(\$48,609)
GMCS O&M	Single Pay	23	(\$1,675,000)	(\$4,128,399)	0.32557	(\$1,344,088)
Institutional Controls, Check and Maintain	Single Pay	23	(\$1,500)	(\$3,697)	0.32557	(\$1,204)
LTGM, Year 11 and Later (Annual)	Single Pay	23	(\$75,000)	(\$184,854)	0.32557	(\$60,183)
GMCS O&M	Single Pay	24	(\$1,675,000)	(\$4,293,534)	0.31007	(\$1,331,287)
Institutional Controls, Check and Maintain	Single Pay	24	(\$1,500)	(\$3,845)	0.31007	(\$1,192)
LTGM, Year 11 and Later (Annual)	Single Pay	24	(\$75,000)	(\$192,248)	0.31007	(\$59,610)
Sediment/Surface Water Sampling (Biennial)	Single Pay	24	(\$60,000)	(\$153,798)	0.31007	(\$47,688)
GMCS O&M	Single Pay	25	(\$1,675,000)	(\$4,465,276)	0.29530	(\$1,318,608)
Institutional Controls, Check and Maintain	Single Pay	25	(\$1,500)	(\$3,999)	0.29530	(\$1,181)
LTGM, Year 11 and Later (Annual)	Single Pay	25	(\$75,000)	(\$199,938)	0.29530	(\$59,042)
GMCS O&M	Single Pay	26	(\$1,675,000)	(\$4,643,887)	0.28124	(\$1,306,050)
Institutional Controls, Check and Maintain	Single Pay	26	(\$1,500)	(\$4,159)	0.28124	(\$1,170)
LTGM, Year 11 and Later (Annual)	Single Pay	26	(\$75,000)	(\$207,935)	0.28124	(\$58,480)
Sediment/Surface Water Sampling (Biennial)	Single Pay	26	(\$60,000)	(\$166,348)	0.28124	(\$46,784)
GMCS O&M	Single Pay	27	(\$1,675,000)	(\$4,829,642)	0.26785	(\$1,293,612)
Institutional Controls, Check and Maintain	Single Pay	27	(\$1,500)	(\$4,325)	0.26785	(\$1,158)
LTGM, Year 11 and Later (Annual)	Single Pay	27	(\$75,000)	(\$216,253)	0.26785	(\$57,923)
GMCS O&M	Single Pay	28	(\$1,675,000)	(\$5,022,828)	0.25509	(\$1,281,291)
Institutional Controls, Check and Maintain	Single Pay	28	(\$1,500)	(\$4,498)	0.25509	(\$1,147)
LTGM, Year 11 and Later (Annual)	Single Pay	28	(\$75,000)	(\$224,903)	0.25509	(\$57,371)
Sediment/Surface Water Sampling (Biennial)	Single Pay	28	(\$60,000)	(\$179,922)	0.25509	(\$45,897)
GMCS O&M	Single Pay	29	(\$1,675,000)	(\$5,223,741)	0.24295	(\$1,269,089)
Institutional Controls, Check and Maintain	Single Pay	29	(\$1,500)	(\$4,678)	0.24295	(\$1,136)
LTGM, Year 11 and Later (Annual)	Single Pay	29	(\$75,000)	(\$233,899)	0.24295	(\$56,825)
GMCS O&M	Single Pay	30	(\$1,675,000)	(\$5,432,691)	0.23138	(\$1,257,002)
Institutional Controls, Check and Maintain	Single Pay	30	(\$1,500)	(\$4,865)	0.23138	(\$1,126)
LTGM, Year 11 and Later (Annual)	Single Pay	30	(\$75,000)	(\$243,255)	0.23138	(\$56,284)
Sediment/Surface Water Sampling (Biennial)	Single Pay	30	(\$60,000)	(\$194,604)	0.23138	(\$45,027)
GMCS O&M	Single Pay	31	(\$1,675,000)	(\$5,649,998)	0.22036	(\$1,245,031)



Solutia, TSR Cost Estimate

AOC:

MHU and DHU

Average or Most Probable Estimate (Including GMCS O&M)

Discount Rate = 5.0%

Inflation Rate = 4.0%

LTGM, Years 3-10 (Semi-Annual)	Single Pay	9	(\$150,000)	(\$213,497)	0.64461	(\$137,622)
GMCS O&M	Single Pay	10	(\$1,675,000)	(\$2,479,409)	0.61391	(\$1,522,142)
Institutional Controls, Check and Maintain	Single Pay	10	(\$1,500)	(\$2,220)	0.61391	(\$1,363)
LTGM, Years 3-10 (Semi-Annual)	Single Pay	10	(\$150,000)	(\$222,037)	0.61391	(\$136,311)
Sediment/Surface Water Sampling (Biennial)	Single Pay	10	(\$60,000)	(\$88,815)	0.61391	(\$54,524)
GMCS O&M	Single Pay	11	(\$1,675,000)	(\$2,578,586)	0.58468	(\$1,507,646)
Institutional Controls, Check and Maintain	Single Pay	11	(\$1,500)	(\$2,309)	0.58468	(\$1,350)
LTGM, Year 11 and Later (Annual)	Single Pay	11	(\$75,000)	(\$115,459)	0.58468	(\$67,507)
GMCS O&M	Single Pay	12	(\$1,675,000)	(\$2,681,729)	0.55684	(\$1,493,287)
Institutional Controls, Check and Maintain	Single Pay	12	(\$1,500)	(\$2,402)	0.55684	(\$1,337)
LTGM, Year 11 and Later (Annual)	Single Pay	12	(\$75,000)	(\$120,077)	0.55684	(\$66,864)
Sediment/Surface Water Sampling (Biennial)	Single Pay	12	(\$60,000)	(\$96,062)	0.55684	(\$53,491)
GMCS O&M	Single Pay	13	(\$1,675,000)	(\$2,788,998)	0.53032	(\$1,479,065)
Institutional Controls, Check and Maintain	Single Pay	13	(\$1,500)	(\$2,498)	0.53032	(\$1,325)
LTGM, Year 11 and Later (Annual)	Single Pay	13	(\$75,000)	(\$124,881)	0.53032	(\$66,227)
GMCS O&M	Single Pay	14	(\$1,675,000)	(\$2,900,558)	0.50507	(\$1,464,979)
Institutional Controls, Check and Maintain	Single Pay	14	(\$1,500)	(\$2,598)	0.50507	(\$1,312)
LTGM, Year 11 and Later (Annual)	Single Pay	14	(\$75,000)	(\$129,876)	0.50507	(\$65,596)
Sediment/Surface Water Sampling (Biennial)	Single Pay	14	(\$60,000)	(\$103,901)	0.50507	(\$52,477)
GMCS O&M	Single Pay	15	(\$1,675,000)	(\$3,016,580)	0.48102	(\$1,451,027)
Institutional Controls, Check and Maintain	Single Pay	15	(\$1,500)	(\$2,701)	0.48102	(\$1,299)
LTGM, Year 11 and Later (Annual)	Single Pay	15	(\$75,000)	(\$135,071)	0.48102	(\$64,971)
GMCS O&M	Single Pay	16	(\$1,675,000)	(\$3,137,244)	0.45811	(\$1,437,207)
Institutional Controls, Check and Maintain	Single Pay	16	(\$1,500)	(\$2,809)	0.45811	(\$1,287)
LTGM, Year 11 and Later (Annual)	Single Pay	16	(\$75,000)	(\$140,474)	0.45811	(\$64,353)
Sediment/Surface Water Sampling (Biennial)	Single Pay	16	(\$60,000)	(\$112,379)	0.45811	(\$51,482)
GMCS O&M	Single Pay	17	(\$1,675,000)	(\$3,262,733)	0.43630	(\$1,423,520)
Institutional Controls, Check and Maintain	Single Pay	17	(\$1,500)	(\$2,922)	0.43630	(\$1,275)
LTGM, Year 11 and Later (Annual)	Single Pay	17	(\$75,000)	(\$146,093)	0.43630	(\$63,740)
GMCS O&M	Single Pay	18	(\$1,675,000)	(\$3,393,243)	0.41552	(\$1,409,962)
Institutional Controls, Check and Maintain	Single Pay	18	(\$1,500)	(\$3,039)	0.41552	(\$1,263)
LTGM, Year 11 and Later (Annual)	Single Pay	18	(\$75,000)	(\$151,936)	0.41552	(\$63,133)
Sediment/Surface Water Sampling (Biennial)	Single Pay	18	(\$60,000)	(\$121,549)	0.41552	(\$50,506)
GMCS O&M	Single Pay	19	(\$1,675,000)	(\$3,528,972)	0.39573	(\$1,396,534)
Institutional Controls, Check and Maintain	Single Pay	19	(\$1,500)	(\$3,160)	0.39573	(\$1,251)
LTGM, Year 11 and Later (Annual)	Single Pay	19	(\$75,000)	(\$158,014)	0.39573	(\$62,531)
GMCS O&M	Single Pay	20	(\$1,675,000)	(\$3,670,131)	0.37689	(\$1,383,234)
Institutional Controls, Check and Maintain	Single Pay	20	(\$1,500)	(\$3,287)	0.37689	(\$1,239)

Solutia, TSR Cost Estimate

AOC:

MHU and DHU

Average or Most Probable Estimate (Including GMCS O&M)

Discount Rate = 5.0%

Inflation Rate = 4.0%

	Type	Year or Years	Cost	Escalated Cost	P-W Factor	Present Worth
<b>Capital Expenditures:</b>						
Additional Wells, Install and Develop	Single Pay	0.5	(\$25,000)	(\$25,495)	0.97590	(\$24,881)
<b>Capital Expenditure Subtotal</b>						<b>(\$24,881)</b>
<b>Periodic Expenditures:</b>						
GMCS O&M	Single Pay	1	(\$1,675,000)	(\$1,742,000)	0.95238	(\$1,659,048)
Institutional Controls, Check and Maintain	Single Pay	1	(\$1,500)	(\$1,560)	0.95238	(\$1,486)
LTGM, First Two Years (Quarterly)	Single Pay	1	(\$300,000)	(\$312,000)	0.95238	(\$297,143)
GMCS O&M	Single Pay	2	(\$1,675,000)	(\$1,811,680)	0.90703	(\$1,643,247)
Institutional Controls, Check and Maintain	Single Pay	2	(\$1,500)	(\$1,622)	0.90703	(\$1,472)
LTGM, First Two Years (Quarterly)	Single Pay	2	(\$300,000)	(\$324,480)	0.90703	(\$294,313)
Sediment/Surface Water Sampling (Biennial)	Single Pay	2	(\$60,000)	(\$64,896)	0.90703	(\$58,863)
GMCS O&M	Single Pay	3	(\$1,675,000)	(\$1,884,147)	0.86384	(\$1,627,597)
Institutional Controls, Check and Maintain	Single Pay	3	(\$1,500)	(\$1,687)	0.86384	(\$1,458)
LTGM, Years 3-10 (Semi-Annual)	Single Pay	3	(\$150,000)	(\$168,730)	0.86384	(\$145,755)
GMCS O&M	Single Pay	4	(\$1,675,000)	(\$1,959,513)	0.82270	(\$1,612,096)
Institutional Controls, Check and Maintain	Single Pay	4	(\$1,500)	(\$1,755)	0.82270	(\$1,444)
LTGM, Years 3-10 (Semi-Annual)	Single Pay	4	(\$150,000)	(\$175,479)	0.82270	(\$144,367)
Sediment/Surface Water Sampling (Biennial)	Single Pay	4	(\$60,000)	(\$70,192)	0.82270	(\$57,747)
GMCS O&M	Single Pay	5	(\$1,675,000)	(\$2,037,894)	0.78353	(\$1,596,743)
Institutional Controls, Check and Maintain	Single Pay	5	(\$1,500)	(\$1,825)	0.78353	(\$1,430)
LTGM, Years 3-10 (Semi-Annual)	Single Pay	5	(\$150,000)	(\$182,498)	0.78353	(\$142,992)
GMCS O&M	Single Pay	6	(\$1,675,000)	(\$2,119,409)	0.74622	(\$1,581,536)
Institutional Controls, Check and Maintain	Single Pay	6	(\$1,500)	(\$1,898)	0.74622	(\$1,416)
LTGM, Years 3-10 (Semi-Annual)	Single Pay	6	(\$150,000)	(\$189,798)	0.74622	(\$141,630)
Sediment/Surface Water Sampling (Biennial)	Single Pay	6	(\$60,000)	(\$75,919)	0.74622	(\$56,652)
GMCS O&M	Single Pay	7	(\$1,675,000)	(\$2,204,186)	0.71068	(\$1,566,474)
Institutional Controls, Check and Maintain	Single Pay	7	(\$1,500)	(\$1,974)	0.71068	(\$1,403)
LTGM, Years 3-10 (Semi-Annual)	Single Pay	7	(\$150,000)	(\$197,390)	0.71068	(\$140,281)
GMCS O&M	Single Pay	8	(\$1,675,000)	(\$2,292,353)	0.67684	(\$1,551,555)
Institutional Controls, Check and Maintain	Single Pay	8	(\$1,500)	(\$2,053)	0.67684	(\$1,389)
LTGM, Years 3-10 (Semi-Annual)	Single Pay	8	(\$150,000)	(\$205,285)	0.67684	(\$138,945)
Sediment/Surface Water Sampling (Biennial)	Single Pay	8	(\$60,000)	(\$82,114)	0.67684	(\$55,578)
GMCS O&M	Single Pay	9	(\$1,675,000)	(\$2,384,047)	0.64461	(\$1,536,778)
Institutional Controls, Check and Maintain	Single Pay	9	(\$1,500)	(\$2,135)	0.64461	(\$1,376)



Solutia, TSR Cost Estimate

AOC:

MHU and DHU

Cost Item	"Average" or "Most Probable" Estimate				"Maximum" or "Most Conservative" Estimate			
	Estimated Quantity	Units	Unit Cost	Extended Cost	Estimated Quantity	Units	Unit Cost	Extended Cost
<i>Capital Cost</i>								
Additional Wells, Install and Develop	5	wells	\$5,000	\$25,000	15	wells	\$7,500	\$112,500
<i>Operation and Maintenance</i>								
GMCS O&M	NA	NA	NA	\$1,675,000	NA	NA	NA	\$1,675,000
Institutional Controls, Check and Maintain	NA	NA	NA	\$1,500	NA	NA	NA	\$1,500
<i>Long-Term Groundwater Monitoring, etc.</i>								
LTGM, First Two Years (Quarterly)	100	well-events	\$3,000	\$300,000	140	well-events	\$3,000	\$420,000
LTGM, Years 3-10 (Semi-Annual)	50	well-events	\$3,000	\$150,000	70	well-events	\$3,000	\$210,000
LTGM, Year 11 and Later (Annual)	25	well-events	\$3,000	\$75,000	35	well-events	\$3,000	\$105,000
Sediment/Surface Water Sampling (Biennial)	15	samples	\$4,000	\$60,000	25	samples	\$4,000	\$100,000



Former PCB Warehouse Area

Discount Rate =	5.0%
Inflation Rate =	4.0%

	Type	Year or Years	Cost	Escalated Cost	P-W Factor	Present Worth
<b>Capital Expenditures:</b>						
Excavation	Single Pay	0.5	(\$2,190)	(\$2,233)	0.97590	(\$2,180)
Transportation and Disposal, PCB-contaminated soil	Single Pay	0.5	(\$58,400)	(\$59,557)	0.97590	(\$58,121)
Confirmatory Sampling	Single Pay	1.0	(\$10,000)	(\$10,400)	0.95238	(\$9,905)
				<b>Capital Expenditure Subtotal</b>		<b>(\$70,206)</b>
<b>Periodic Expenditures:</b>						
Not applicable						
				<b>Periodic Expenditure Subtotal</b>		<b>\$ -</b>
				<b>TOTAL PRESENT WORTH COST</b>		<b>(\$70,206)</b>

# Solutia, TSR Cost Estimate

AOC:

Former PCB Warehouse Area

Cost Item	"Average" or "Most Probable" Estimate				"Maximum" or "Most Conservative" Estimate			
	Estimated Quantity	Units	Unit Cost	Extended Cost	Estimated Quantity	Units	Unit Cost	Extended Cost
<i>Capital Cost</i>								
Excavation	146	CY	\$10	\$1,460	146	CY	\$15	\$2,190
Transportation and Disposal, PCB-contaminated soil	234	tons	\$150	\$35,040	234	tons	\$250	\$58,400
Confirmatory Sampling	NA	NA	NA	\$5,000	NA	NA	NA	\$10,000
<i>Operation and Maintenance</i>								
Covered under estimate for the MHU/DHU								
<i>Long-Term Monitoring</i>								
Covered under estimate for the MHU/DHU								

## Average or Most Probable Estimate

Discount rate = 5.0%  
Inflation Rate = 4.0%

	Type	Year or Years	Cost	Escalated Cost	P-W Factor	Present Worth
<b>Capital Expenditures:</b>						
Excavation	Single Pay	0.5	(\$1,460)	(\$1,489)	0.97590	(\$1,453)
Transportation and Disposal, PCB-contaminated soil	Single Pay	0.5	(\$35,040)	(\$35,734)	0.97590	(\$34,873)
Confirmatory Sampling	Single Pay	1.0	(\$5,000)	(\$5,200)	0.95238	(\$4,952)
Capital Expenditure Subtotal						(\$41,278)
<b>Periodic Expenditures:</b>						
Not applicable						
Periodic Expenditure Subtotal						\$ -
TOTAL PRESENT WORTH COST						(\$41,278)

	Type	Year or Years	Cost	Escalated Cost	P-W Factor	Present Worth
<b>Capital Expenditures:</b>						
SVE System(s)	Single Pay	0.5	(\$240,000)	(\$244,753)	0.97590	(\$238,854)
Institutional Controls	Single Pay	0.5	(\$5,000)	(\$5,099)	0.97590	(\$4,976)
Construction Cost Contingency	Single Pay	0.5	(\$24,000)	(\$24,475)	0.97590	(\$23,885)
				<b>Capital Expenditure Subtotal</b>		<b>(\$267,716)</b>
<b>Periodic Expenditures:</b>						
SVE System(s) O&M	Single Pay	1	(\$48,000)	(\$49,920)	0.95238	(\$47,543)
Institutional Controls, Check and Maintain	Single Pay	1	(\$1,000)	(\$1,040)	0.95238	(\$990)
SVE System(s) O&M	Single Pay	2	(\$48,000)	(\$51,917)	0.90703	(\$47,090)
Institutional Controls, Check and Maintain	Single Pay	2	(\$1,000)	(\$1,082)	0.90703	(\$981)
SVE System(s) O&M	Single Pay	3	(\$48,000)	(\$53,993)	0.86384	(\$46,642)
Institutional Controls, Check and Maintain	Single Pay	3	(\$1,000)	(\$1,125)	0.86384	(\$972)
SVE System(s) O&M	Single Pay	4	(\$48,000)	(\$56,153)	0.82270	(\$46,197)
Institutional Controls, Check and Maintain	Single Pay	4	(\$1,000)	(\$1,170)	0.82270	(\$962)
SVE System(s) O&M	Single Pay	5	(\$48,000)	(\$58,399)	0.78353	(\$45,757)
Institutional Controls, Check and Maintain	Single Pay	5	(\$1,000)	(\$1,217)	0.78353	(\$953)
Confirmatory Sampling and Analysis	Single Pay	5	(\$50,000)	(\$60,833)	0.78353	(\$47,664)
				<b>Periodic Expenditure Subtotal</b>		<b>(\$238,088)</b>
				<b>TOTAL PRESENT WORTH COST</b>		<b>(\$505,804)</b>



Solutia, TSR Cost Estimate

AOC:

North Plant Area

Cost Item	"Average" or "Most Probable" Estimate				"Maximum" or "Most Conservative" Estimate			
	Estimated Quantity	Units	Unit Cost	Extended Cost	Estimated Quantity	Units	Unit Cost	Extended Cost
<i>Capital Cost</i>								
SVE System(s)	24,000	CY	\$5.00	\$120,000	24,000	CY	\$10.00	\$240,000
Institutional Controls	NA	NA	NA	\$3,000	NA	NA	NA	\$5,000
Construction Cost Contingency	NA	NA	NA	\$12,000	NA	NA	NA	\$24,000
<i>Operation and Maintenance (Annual)</i>								
SVE System(s) O&M	24,000	CY	\$1.00	\$24,000	24,000	CY	\$2.00	\$48,000
Institutional Controls, Check and Maintain	NA	NA	NA	\$1,000	NA	NA	NA	\$1,000
<i>Long-Term Monitoring</i>								
Confirmatory Sampling and Analysis	NA	NA	NA	\$30,000	NA	NA	NA	\$50,000

Average or Most Probable Estimate

Discount Rate = 5.0%

Inflation Rate = 4.0%

	Type	Year or Years	Cost	Escalated Cost	P-W Factor	Present Worth
<b>Capital Expenditures:</b>						
SVE System(s)	Single Pay	0.5	(\$120,000)	(\$122,376)	0.97590	(\$119,427)
Institutional Controls	Single Pay	1.0	(\$3,000)	(\$3,120)	0.95238	(\$2,971)
Construction Cost Contingency	Single Pay	1.0	(\$12,000)	(\$12,480)	0.95238	(\$11,886)
				<b>Capital Expenditure Subtotal</b>		<b>(\$134,284)</b>
<b>Periodic Expenditures:</b>						
SVE System(s) O&M	Single Pay	1	(\$24,000)	(\$24,960)	0.95238	(\$23,771)
Institutional Controls, Check and Maintain	Single Pay	1	(\$1,000)	(\$1,040)	0.95238	(\$990)
SVE System(s) O&M	Single Pay	2	(\$24,000)	(\$25,958)	0.90703	(\$23,545)
Institutional Controls, Check and Maintain	Single Pay	2	(\$1,000)	(\$1,082)	0.90703	(\$981)
Confirmatory Sampling and Analysis	Single Pay	2	(\$30,000)	(\$32,448)	0.90703	(\$29,431)
				<b>Periodic Expenditure Subtotal</b>		<b>(\$78,719)</b>
				<b>TOTAL PRESENT WORTH COST</b>		<b>(\$213,004)</b>

AOC:

Maximum or Most Conservative Estimate

Discount Rate =

5.0%

Inflation Rate =

4.0%

	Type	Year or Years	Cost	Escalated Cost	P-W Factor	Present Worth
<b>Capital Expenditures:</b>						
SVE System(s)	Single Pay	0.5	(\$1,020,000)	(\$1,040,200)	0.97590	(\$1,015,131)
Excavation	Single Pay	0.5	(\$12,195)	(\$12,437)	0.97590	(\$12,137)
Transportation and Disposal, PCBs- and SVOCs-contaminated	Single Pay	0.5	(\$136,400)	(\$139,101)	0.97590	(\$135,749)
Institutional Controls	Single Pay	0.5	(\$5,000)	(\$5,099)	0.97590	(\$4,976)
Construction Cost Contingency	Single Pay	0.5	(\$102,000)	(\$104,020)	0.97590	(\$101,513)
				<b>Capital Expenditure Subtotal</b>		<b>(\$1,269,506)</b>
<b>Periodic Expenditures:</b>						
SVE System(s) O&M	Single Pay	1	(\$204,000)	(\$212,160)	0.95238	(\$202,057)
Institutional Controls, Check and Maintain	Single Pay	1	(\$1,000)	(\$1,040)	0.95238	(\$990)
SVE System(s) O&M	Single Pay	2	(\$204,000)	(\$220,646)	0.90703	(\$200,133)
Institutional Controls, Check and Maintain	Single Pay	2	(\$1,000)	(\$1,082)	0.90703	(\$981)
SVE System(s) O&M	Single Pay	3	(\$204,000)	(\$229,472)	0.86384	(\$198,227)
Institutional Controls, Check and Maintain	Single Pay	3	(\$1,000)	(\$1,125)	0.86384	(\$972)
SVE System(s) O&M	Single Pay	4	(\$204,000)	(\$238,651)	0.82270	(\$196,339)
Institutional Controls, Check and Maintain	Single Pay	4	(\$1,000)	(\$1,170)	0.82270	(\$962)
SVE System(s) O&M	Single Pay	5	(\$204,000)	(\$248,197)	0.78353	(\$194,469)
Institutional Controls, Check and Maintain	Single Pay	5	(\$1,000)	(\$1,217)	0.78353	(\$953)
Confirmatory Sampling and Analysis	Single Pay	5	(\$50,000)	(\$60,833)	0.78353	(\$47,664)
				<b>Periodic Expenditure Subtotal</b>		<b>(\$996,084)</b>
				<b>TOTAL PRESENT WORTH COST</b>		<b>(\$2,265,590)</b>

AOC:

Average or Most Probable Estimate

5.0%

4.0%

	Type	Year or Years	Cost	Escalated Cost	P-W Factor	Present Worth
<b>Capital Expenditures:</b>						
SVE System(s)	Single Pay	0.5	(\$510,000)	(\$520,100)	0.97590	(\$507,566)
Excavation	Single Pay	0.5	(\$8,130)	(\$8,291)	0.97590	(\$8,091)
Transportation and Disposal	Single Pay	0.5	(\$81,840)	(\$83,461)	0.97590	(\$81,449)
Institutional Controls	Single Pay	1.0	(\$3,000)	(\$3,120)	0.95238	(\$2,971)
Construction Cost Contingency	Single Pay	1.0	(\$51,000)	(\$53,040)	0.95238	(\$50,514)
				<b>Capital Expenditure Subtotal</b>		<b>(\$650,592)</b>
<b>Periodic Expenditures:</b>						
SVE System(s) O&M	Single Pay	1	(\$102,000)	(\$106,080)	0.95238	(\$101,029)
Institutional Controls, Check and Maintain	Single Pay	1	(\$1,000)	(\$1,040)	0.95238	(\$990)
SVE System(s) O&M	Single Pay	2	(\$102,000)	(\$110,323)	0.90703	(\$100,066)
Institutional Controls, Check and Maintain	Single Pay	2	(\$1,000)	(\$1,082)	0.90703	(\$981)
Confirmatory Sampling and Analysis	Single Pay	2	(\$30,000)	(\$32,448)	0.90703	(\$29,431)
				<b>Periodic Expenditure Subtotal</b>		<b>(\$232,498)</b>
				<b>TOTAL PRESENT WORTH COST</b>		<b>(\$883,090)</b>



Solutia, TSR Cost Estimate

AOC:

Former Chlorobenzene and Benzene Storage Area

Cost Item	<i>"Average" or "Most Probable" Estimate</i>				<i>"Maximum" or "Most Conservative" Estimate</i>			
	Estimated Quantity	Units	Unit Cost	Extended Cost	Estimated Quantity	Units	Unit Cost	Extended Cost
<i>Capital Cost</i>								
SVE System(s)	102,000	CY	\$5.00	\$510,000	102,000	CY	\$10.00	\$1,020,000
Excavation	813	CY	\$10.00	\$8,130	813	CY	\$15	\$12,195
Transportation and Disposal, PCBs- and SVOCs-contaminated soil	546	tons	\$150.00	\$81,840	546	tons	\$250	\$136,400
Transportation and Disposal, metals-contaminated soil	755	tons	\$40.00	\$30,208	755	tons	\$60	\$45,312
Institutional Controls	NA	NA	NA	\$3,000	NA	NA	NA	\$5,000
Construction Cost Contingency	NA	NA	NA	\$51,000	NA	NA	NA	\$102,000
<i>Operation and Maintenance (Annual)</i>								
SVE System(s) O&M	102,000	CY	\$1.00	\$102,000	102,000	CY	\$2.00	\$204,000
Institutional Controls, Check and Maintain	NA	NA	NA	\$1,000	NA	NA	NA	\$1,000
<i>Long-Term Monitoring</i>								
Confirmatory Sampling and Analysis	NA	NA	NA	\$30,000	NA	NA	NA	\$50,000

### Central Plant Process Area

Inflation Rate = 4.0%

	Type	Year or Years	Cost	Escalated Cost	P-W Factor	Present Worth
<b>Capital Expenditures:</b>						
SVE System(s)	Single Pay	0.5	(\$1,000,000)	(\$1,019,804)	0.97590	(\$995,227)
Excavation	Single Pay	0.5	(\$39,000)	(\$39,772)	0.97590	(\$38,814)
Transportation and Disposal, BAP- and metals-contaminat	Single Pay	0.5	(\$249,600)	(\$254,543)	0.97590	(\$248,409)
Institutional Controls	Single Pay	0.5	(\$5,000)	(\$5,099)	0.97590	(\$4,976)
Construction Cost Contingency	Single Pay	0.5	(\$128,860)	(\$131,412)	0.97590	(\$128,245)
				<b>Capital Expenditure Subtotal</b>		<b>(\$1,415,670)</b>
<b>Periodic Expenditures:</b>						
SVE System(s) O&M	Single Pay	1	(\$200,000)	(\$208,000)	0.95238	(\$198,095)
Institutional Controls, Check and Maintain	Single Pay	1	(\$1,000)	(\$1,040)	0.95238	(\$990)
SVE System(s) O&M	Single Pay	2	(\$200,000)	(\$216,320)	0.90703	(\$196,209)
Institutional Controls, Check and Maintain	Single Pay	2	(\$1,000)	(\$1,082)	0.90703	(\$981)
SVE System(s) O&M	Single Pay	3	(\$200,000)	(\$224,973)	0.86384	(\$194,340)
Institutional Controls, Check and Maintain	Single Pay	3	(\$1,000)	(\$1,125)	0.86384	(\$972)
SVE System(s) O&M	Single Pay	4	(\$200,000)	(\$233,972)	0.82270	(\$192,489)
Institutional Controls, Check and Maintain	Single Pay	4	(\$1,000)	(\$1,170)	0.82270	(\$962)
SVE System(s) O&M	Single Pay	5	(\$200,000)	(\$243,331)	0.78353	(\$190,656)
Institutional Controls, Check and Maintain	Single Pay	5	(\$1,000)	(\$1,217)	0.78353	(\$953)
Confirmatory Sampling and Analysis	Single Pay	5	(\$40,000)	(\$48,666)	0.78353	(\$38,131)
				<b>Periodic Expenditure Subtotal</b>		<b>(\$976,648)</b>
				<b>TOTAL PRESENT WORTH COST</b>		<b>(\$2,392,318)</b>

	Type	Year or Years	Cost	Escalated Cost	P-W Factor	Present Worth
<b>Capital Expenditures:</b>						
SVE System(s)	Single Pay	0.5	(\$500,000)	(\$509,902)	0.97590	(\$497,613)
Excavation	Single Pay	0.5	(\$26,000)	(\$26,515)	0.97590	(\$25,876)
Transportation and Disposal	Single Pay	0.5	(\$166,400)	(\$169,695)	0.97590	(\$165,606)
Institutional Controls	Single Pay	1.0	(\$3,000)	(\$3,120)	0.95238	(\$2,971)
Construction Cost Contingency	Single Pay	1.0	(\$69,240)	(\$72,010)	0.95238	(\$68,581)
				<b>Capital Expenditure Subtotal</b>		<b>(\$760,647)</b>
<b>Periodic Expenditures:</b>						
SVE System(s) O&M	Single Pay	1	(\$100,000)	(\$104,000)	0.95238	(\$99,048)
Institutional Controls, Check and Maintain	Single Pay	1	(\$1,000)	(\$1,040)	0.95238	(\$990)
SVE System(s) O&M	Single Pay	2	(\$100,000)	(\$108,160)	0.90703	(\$98,104)
Institutional Controls, Check and Maintain	Single Pay	2	(\$1,000)	(\$1,082)	0.90703	(\$981)
Confirmatory Sampling and Analysis	Single Pay	2	(\$25,000)	(\$27,040)	0.90703	(\$24,526)
				<b>Periodic Expenditure Subtotal</b>		<b>(\$223,650)</b>
				<b>TOTAL PRESENT WORTH COST</b>		<b>(\$984,296)</b>



Solutia, TSR Cost Estimate

AOC:

Central Plant Process Area

Cost Item	<i>"Average" or "Most Probable" Estimate</i>				<i>"Maximum" or "Most Conservative" Estimate</i>			
	Estimated Quantity	Units	Unit Cost	Extended Cost	Estimated Quantity	Units	Unit Cost	Extended Cost
<i>Capital Cost</i>								
SVE System(s)	100,000	CY	\$5.00	\$500,000	100,000	CY	\$10.00	\$1,000,000
Excavation	2,600	CY	\$10.00	\$26,000	2,600	CY	\$15	\$39,000
Transportation and Disposal, BAP- and metals-contaminated soil	4,160	tons	\$40.00	\$166,400	4,160	tons	\$60	\$249,600
Institutional Controls	NA	NA	NA	\$3,000	NA	NA	NA	\$5,000
Construction Cost Contingency	NA	NA	NA	\$69,240	NA	NA	NA	\$128,860
<i>Operation and Maintenance (Annual)</i>								
SVE System(s) O&M	100,000	CY	\$1.00	\$100,000	100,000	CY	\$2.00	\$200,000
Institutional Controls, Check and Maintain	NA	NA	NA	\$1,000	NA	NA	NA	\$1,000
<i>Long-Term Monitoring</i>								
Confirmatory Sampling and Analysis	NA	NA	NA	\$25,000	NA	NA	NA	\$40,000